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Editorial.

Soil Erosion.

IT is impossible in a hilly country like Ceylon to avoid frequent allusion to the question of soil erosion. With the burst of every monsoon one sees the capital of up-country agriculture still being washed out to sea. It is true that much has been done in recent years to check the wash, but no one can yet consider the position satisfactory and it is therefore imperative that the Department of Agriculture should keep the problem before the agricultural public.

The introduction of Vigna into rubber cultivations has resulted in a great reduction of soil erosion on rubber estates. Its use can however still be extended.

The following extracts from the Administration Report of the Department of Agriculture for 1927 should be of general interest:—

> The Department has endeavoured to encourage a sustained interest in this important question. The importance of soil conservation in the hill country is recognized by all and much has been accomplished in recent years. Much, however, still remains to be done, particularly on tea estates. The opening of new tea areas without contour planting is still general and the use of leguminous cover crops in tea is not being extended as rapidly as could be hoped for. It is admitted that there are considerable practical difficulties in adopting the contour system of planting, but these must be overcome, as the Department is convinced that for the prevention of soil erosion in tea the planting of contour hedges of tea at varying distances down the slopes is the most satisfactory method of dealing with an admittedly difficult problem. The use of leguminous cover crops in tea is the subject of careful experiment on the Central Experiment Station at Peradeniya. *Indigofera Endecaphylla* has so far been found to be the most suitable cover crop for tea and careful records of the effects of this crop upon the moisture and chemical composition of the soil and upon the yields of tea are being kept. Up to date, it has been established that for the first two years the moisture content of the soil is reduced by the evaporation from the cover crop but afterwards it is increased by reason of the leafy mulch which is formed on the surface of the soil. The soil tilth has also been markedly improved as the result of growing *Indigofera* and cultivation is rendered easier than in uncovered soil.
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> It now remains to establish how such a cover crop as *Indigofera* in tea can be utilized to the greatest advantage. The experiments at Peradeniya do not permit of the *Indigofera* being lopped and buried, as

such a treatment would upset the routine treatment which the tea plots had previously had, but it is anticipated that in practice it would be found possible to cut the *Indigofera* and incorporate it into the soil behind the fork when envelope forking is being done. Soil under *Indigofera* is easy to fork and it is quite easy to roll this cover crop back and cut it, as it does not root from every internode as is the case with many other cover crops. The tea in *Indigofera* on the Experiment Station came to its time of pruning in very good condition. It was green, healthy, and vigorous at pruning time and has recovered rapidly, with but a small percentage of losses. The general conclusions which can safely be drawn from the results of the experiments so far obtained indicate that the use of such a cover crop as *Indigofera* can safely be encouraged in tea cultivation in Ceylon. Its use will tend not only to prevent soil erosion, but also provide for the building up of a better soil. The experiments clearly indicate that its extended trial can safely be recommended. A few estates have already established *Indigofera* over considerable areas, and the results so far reported have all been encouraging. There is little doubt that if contour hedge planting were adopted in new clearings and use made of cover crops, such as *Indigofera,* from the beginning in addition to the usual contour drains and silt pits, the loss of valuable top-soil could be reduced to a minimum.

Much, however, still remains to be done, and until every planter in the up-country realizes that this is his main agricultural problem the situation cannot be considered to be satisfactory. If soil erosion can be checked and general soil condition and tilth maintained, crop yields will be sustained without the aid of increasing quantities of artificial fertilizers and the incidence of pests and diseases will be reduced. As stated above *Indigofera endecaphylla* is still considered to be the most suitable for tea. It will not grow under shade and therefore is of no value in old rubber. Vigna (*Dolichos Hosei*) is the most suitable for old rubber. It stands shade well, but is sometimes damaged by snails. Small patches are also killed out in wet weather by *Rhizoctonia solani.* Vigna is not easy to establish in all localities. At Peradeniya it has been found difficult to establish, but it was found in 1927 that very much greater success was obtained if, instead of the indiscriminate planting of creepers, only rooted runners of plants were put out. *Centrosema pubescens* forms a good cover at Peradeniya and it can be propagated from seed or cuttings. The cover is thicker than that of Vigna, but this plant does not appear to thrive so satisfactorily in the heavy shade of old rubber. It is better suited for young rubber or for new clearings. For the latter also *Calopogonium mucunoides* is being tried. It forms a dense heavy cover and climbing up the young plants must be prevented.

In our present number of the *Tropical Agriculturist* is included a brief memorandum on a system of drainage devised to reduce soil erosion. This article has been especially prepared by Mr. Felsinger at our request. The system of drainage described has been used by him on his Fruit Hill and Primrose Hill Estates and the results so far have been most satisfactory. Not only has soil erosion been checked but better growth of the tea has followed the adoption of this system. Others who have found successful methods of preventing soil erosion are invited to communicate them to the *Tropical Agriculturist.*

Original Articles.

Cultivation of Chaulmoogra Oils for the Treatment of Leprosy.

F. A. STOCKDALE, C.B.E., M.A., F.L.S.,

Director of Agriculture.

THE Secretary of State for the Colonies in a Circular despatch, dated April 25th, 1925, drew the attention of Government to the probable increase in the demand for the various species of the chaulmoogra nut in the treatment of leprosy and stated that the Colonial Advisory Medical and Sanitary Committee suggested that specimens of *Taraktogenos Kurzii* and *Hydnocarpus wightiana* might be grown in some parts of the British Empire.

The following summary was drawn up for the information of Government in 1926:—

Taraktogenos Kurzii, King, is recorded (1) as a synonym for *Hydnocarpus heterophyllus*, Kurz (not Blume), and is a large tree 40—50 feet high found in Eastern Bengal and Assam, and yields the Chaulmoogra seeds of commerce. These are brought to Calcutta at the end of the rainy season in November and December, chiefly from Chittagong. They are collected from the forests and consist of mature seed with a brown kernel rich in oil and immature seed with a black kernel containing a smaller proportion of oil of a dirty colour. The trade is mainly in the hands of the Bengali traders, but occasionally sales by public auction occur in Calcutta. Chaulmoogra seeds have also been used for centuries in Burma and seeds of *Taraktogenos Kurzii* and of closely related species are sold in the bazaars of that country under the name of "Kalaw."

The satisfactory results obtained in the treatment of leprosy in the Hawaiian Islands (2, 3, 4), aroused a good deal of public interest and in 1919 the Department of Agriculture of the United States of America deputed an officer (Mr. J. F. Rock) to make a full investigation in the East of the Chaulmoogra trees and their

related species. The report of this investigation which was made in Siam, Burma, Malaya, Bengal, and South India was published in 1922 (5) and concludes as follows:—

"The facts brought to light in this recent survey show that the dealers in chaulmoogra oil (that derived from *Taraktogenos kurzii*) have never seen the tree in its wild state. Even the native Bengal dealers in Chittagong had not been in the forests of the Chittagong Hill tracts. All depend on jungle people for collecting the seeds, which are known by different native names in the various regions in which they grow. Smith, Stanistreet & Co., of Calcutta, claimed to have a tree growing in their compound, but on examination it was found not even to belong to the family *Flacourticeae*, to which Taraktogenos belongs. The collecting of the seeds is, then, in the hands of jungle people, who are more or less indolent. Moreover, the conditions under which these seeds are collected are such, as has already been explained, that at least 50 per cent. of the crop is lost every year. The Burmese name kalaw is applied to more than one species, and these species resemble each other so closely that the jungle people make no distinction between them. Seeds of these trees are sent to markets and bazaars under the collective name of kalaw, where they are bought up by dealers who manufacture chaulmoogra oil from them.

"Another point of interest and one of which very little is known is that *Taraktogenos kurzii* and kindred species do not bear a regular yearly crop but fruit sporadically and sometimes are without fruit for two years or more. The natives stated that fruit is collected by them every three years. The causes of the irregular fruiting habit of chaulmoogra trees are not known, but the fact that the trees are polygamous may have something to do with this. The flowers are undoubtedly dependent on insects for pollination, and while it is said of the species of *Hydnocarpus* that male flowers with rudimentary ovaries and female flowers with regular stamens but without pollen occur at the same time with strictly male and female flowers, it must be stated that on the trees of *Hydnocarpus anthelmintica* (in Bangkok) and of *H. curtisii* (in Penang) examined by the writer, only male flowers were found, and in the first species male flowers with a well-developed hirsute style. It may also be that this group of trees does not flower every year and that they are biennial fruiters. It is well worth while to study these questions, as very little is known of the flowering habits of these trees; in fact, the female flowers of *Taraktogenos kurzii* have never been found.

"The remoteness from civilized centres of the forests where these trees occur, the danger and difficulty encountered in collecting the seeds (which may not be found every year), and also the conditions under which seeds are at present collected would point to the necessity of starting plantations of *Taraktogenos kurzii*, which is known to yield the true chaulmoogra oil, and also of such species of Taraktogenos, Hydnocarpus, and Asteriastigma as yield oils of similar composition. This would assume a steady supply and uniform crop and avoid the possibility of having several species confused, as undoubtedly is the case at present in certain localities. It has been stated by an eminent authority that owing to the very encouraging work carried on in Hawaii and the great success achieved in the treatment of leprosy with chaulmoogra oil derivatives, the lowest yearly demand will be for 1,000,000 litres of oil. The present output, the conditions under which the seeds are collected, and the uncertain fruiting periods of these species makes it certain that the demand will far exceed the output. With this in view, the expedition was undertaken by the writer, of whose work this is a preliminary report, for the purpose of securing viable seeds of as many species as possible, and these seeds are now growing in several places,

"The following suggestions are offered regarding the requirements for establishing plantations of *Taraktogenos kurzii*. The soil should be of a sandy nature, preferably quartz sand. Perfect drainage is necessary, and undulating or hilly land is preferable. The region should have a distinct rainy season with a pronounced dry season in the winter months, but still with considerable humidity. The winter temperature should not fall below 40°F. The foregoing represent approximately the climatic and soil conditions of this species in its native habitat. Other species such as *Hydnocarpus anthelmintica*, require slightly different conditions; but all species of Hydnocarpus and Taraktogenos require well drained sandy or loamy silt soils and grow best along creek beds or on the banks of streams. All require climates necessary for an evergreen rain forest, such as is found in Burma and elsewhere in India."

With the object of supplying Chaulmoogra oil for the treatment of leprosy in the Territory of Hawaii the Board of Agriculture and Forestry established (6) a plantation of 28 acres with the following trees:—

Hydnocarpus anthelminticus (the chaulmoogra tree of Siam) 2070 plants.

Taraktogenos Kurzii (the chaulmoogra or Kalaw tree of Upper Burma) 850 plants.

Hydnocarpus castanea (the Kalaw tree of Lower Burma) 80 plants.

These plants were raised from seed collected by Mr. Rock and it is stated that the most valuable tree is *Taraktogenos Kurzii* although the oil of the other two species seems to give equally good results. This plantation was spaced out 20 feet by 20 feet.

Avenues of *Hydnocarpus anthelminticus* exist in Indo-China (7) but the growth is reported to have been slow. It is thought that this has been due to their full exposure to sun as this tree occurs in the forests of Indo-China especially around Cambodia and requires light shade during its early period of growth. *Hydnocarpus anthelminticus* is reported (8) to have grown in Hawaii to a height of 12 feet in two years and it is expected that seed will be secured when the trees are about 10 years of age. Efforts to grow this species are also being made in Martinique and in New Caledonia. (9).

Three plants of *Taraktogenos Kurzii* received in Dominica, West Indies, in 1920 have grown well and are expected to produce fruit in 7-8 years and seedlings of *Taraktogenos Kurzii*, *Hydnocarpus anthelminticus* and *Hydnocarpus castanea* received in 1922 from the Rock collection are all growing well. (10).

Hydnocarpus Wightiana is indigenous to the Western Peninsula of India and the oil from its seeds has been used in the Bombay Presidency with satisfactory results. This oil resembles chaulmoogra oil in physical properties and in chemical composition.

The Position in Ceylon.

In 1921, when public attention was first drawn to the uses of chaulmoogra oil in the treatment of leprosy seed of *Taraktogenos Kurzii* was secured from the Divisional Forest Officer in Sylhet. Germination of the seed was poor, but 20 plants were raised and 14 of these were planted in Peradeniya and six at Heneratgoda. The growth at the latter garden has been the more satisfactory and the plants appear to do the best when they are sheltered from the wind. A further consignment of seed was secured in 1922, but it failed to germinate.

The genus Hydnocarpus is represented in Ceylon by *Hydnocarpus venenata* S. Makulu, T. Makal, which is common up to about 2,000 feet and the oil of which is employed in skin complaints. *H. alpina* is common in the low country particularly in the dry districts and *H. octandra* a somewhat rare plant in the moist low country particularly the Pasdun Korale.

In the Royal Botanic Gardens at Peradeniya the genus is represented by *H. venenata* and *H. octandra* two of the Ceylon species and by *H. heterophylla* Blume. These are all large and fruit-bearing specimens and are between 30 and 50 years of age. This last tree was labelled at Peradeniya *H. Wightiana* but when in Calcutta last year I found that it differed from the specimens growing in those gardens and upon my return to Ceylon I had full herbarium material sent to Calcutta. The tree labelled in the Royal Botanic Gardens, Peradeniya, *Wightiana* has been identified as *alpina* and our tree labelled *octandra* as *heterophylla* Blume. This latter is identical with *Taraktogenos Blumii* a native of Sumatra of which there is another large tree in the Arboretum. The Systematic Botanist is not however satisfied with the Calcutta determination of *alpina* as the fruits are larger than those usually secured from the wild Ceylon plant.

Further supplies of seed of *Taraktogenos Kurzii* were received from Burma and 100 plants have been raised and will be ready for planting out in a couple of months and over 40 lb. of *H. Wightiana* seed have been secured from South India and from the Royal Botanic Gardens, Calcutta. *Taraktogenos Kurzii* grows in Burma on soil which consists largely of quartz sand and is associated with species of *Dipterocarpus*, *Garcinia* and *Terminalia* and the *Hydnocarpus*, *Shorea*, *Caryota*, *Lagerstroemia* and *Bauhinia*. The preparation of the oil is simple. The seeds when they arrive from the forests are washed and then dried in the sun for one or two days. They are then shelled, sorted and placed between corrugated rollers worked by a hand crane where they are crushed. They are then placed to a thickness of about an inch in jute bags and placed in layers

in a hydraulic press. The cold drawn oil is collected in cans and filtered through ordinary blotting paper. The resulting cake contains 6% of nitrogen and is sold for manure.

Proposals for Ceylon.

I would therefore recommend that the Taraktogenos plants be planted out at Heneratgoda and that bulk of the Hydnocarpus plants be planted at Peradeniya and a small number at Heneratgoda.

There is in the Heneratgoda Gardens 4 acres of Mukalana forest which has been allowed to remain uncleared. This area could be utilized for the trial of the plants which will be available shortly. Part could be cleared in August for planting in October with Taraktogenos and the remaining portion cleared next February-March for planting Hydnocarpus with the South West Monsoon. On the Experiment Station, Peradeniya, 10 acres could be cleared next February-March for planting Hydnocarpus if the germination of the recently imported seed is satisfactory.

No data is available as to the commercial prospects before the cultivation of these plants. It is stated that the world's demand may be nearly 250,000 gallons of oil. The yield of oil is about 30—33% of the weight of the seed. The present purified Taraktogenos oil is Rs. 15/- per gallon, but Hydnocarpus oil is cheaper. Prices for the seed in Calcutta appear to vary from Rs. 5-15 per maund of 82 2/7 lb. No data is available as to the yields from cultivated trees, but it is certain that if the world's demand is to be met it must be from cultivated trees as the wild sources of supply are in difficult and isolated country infested with wild animals. From such areas increasing supplies are not expected to be realized.

Further Investigations.

Further investigations should be made by the Government Analyst and the Medical Department of the oils of the Ceylon species of Hydnocarpus viz., *H. venenata*, *H. alpina*, and *H. octandra*.

The oil of *H. venenata* is known to the villagers to be useful in certain skin complains. The oil of *H. venenata* was shown by Bill (11) to contain both chaulmoogra and hydnocarpic acids and de Wolff and Koldewijn (12) determined the physical constituents of the oil from *H. alpina* Wight and found them to agree closely with those of chaulmoogra oil. It is quite possible that the oil from the Ceylon species may be useful in the treatment of leprosy and this question should be carefully investigated.

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Further Report Regarding Investigations Made in Connexion with Plants Producing Chaulmoogra Oils for the Treatment of Leprosy.

A report dated June 29, 1926, suggested the establishment of plantations of *Taraktogenos Kurzii* and *Hydnocarpus Wightiana* at Heneratgoda and of *Hydnocarpus Wightiana* at Peradeniya, and that further investigations should be made of the oils of the Ceylon species of Hydnocarpus—*H. venenata*, *H. alpina* and *H. octandra*. These proposals received the sanction of Government and the necessary funds for the experiments were voted by the Legislative Council.

In the West India Committee Circular for September 9th, 1926, Dr. Leonard Rogers, Honorary Medical Secretary of the British Empire Leprosy Association reported that the oil of *Hydnocarpus Wightiana* was more valuable than the oil of *Taraktogenos Kurzii* in the treatment of leprosy, because the Hydnocarpic acid appeared to be more active than the chaulmoogric acid. It was therefore decided to concentrate more upon plantations of *Hydnocarpus Wightiana* than upon *Taraktogenos Kurzii* and to make trials of both at Peradeniya and Heneratgoda.

Taraktogenos Kurzii at Heneratgoda,

Aged, 1 Year and 5 Months.

Taraktogenos Kurzii at Peradeniya,

Aged, 1 Year and 5 Months.

Hydnocarpus Wightiana at Heneratgoda,
Aged, 1 Year and 3 Months.

Hydnocarpus Wightiana at Peradeniya,
Aged, 1 Year and 5 Months.

Seed of authenticated *Hydnocarpus Wightiana* was secured from the trees growing in the Royal Botanic Gardens, Calcutta, and through the Director of those Gardens from South India. The seed from the Botanic Gardens, Calcutta, which was received in small consignments as it matured on the trees growing in the Gardens germinated satisfactorily, but the only consignment of seed from South India which gave any germination was one received in powdered charcoal and packed in an atmosphere of carbon dioxide gas. Seed of *Taraktogenos Kurzii* was secured from the Conservator of Forests, Burma, and germination was only fair.

The seed was sown in the nurseries at the Royal Botanic Gardens, Peradeniya, in nursery beds and the seedlings were subsequently planted out into bamboo pots until they were large enough to be put out into the field.

Some doubt existed as to the naming of tree labelled *Hydnocarpus alpina* in the Royal Botanic Gardens, Peradeniya, and referred to in the previous report, and it was thought by the Systematic Botanist that it might be *Hydnocarpus anthelmintica*. Botanical specimens were sent to the Botanical Survey of India at Calcutta and also to the Royal Botanic Gardens, Kew, and after some correspondence it has been definitely decided that our plant is *H. anthelmintica*—the oil from the seeds of which according to Dr. Muir, the Director of the Leprosy Research Laboratory at Calcutta, is as efficacious as that from the seeds of *H. Wightiana*. In consequence it has been decided to make a trial with this plant and 50 plants of *H. anthelmintica* have been put out at Heneratgoda.

The position, therefore, as far as the Department of Agriculture is concerned, is as follows:—

At the Experiment Station, Peradeniya, 2·87 acres have been planted up with 48 plants of *Taraktogenos Kurzii* and 263 plants of *Hydnocarpus Wightiana* and $3\frac{3}{4}$ acres at the Botanic Gardens, Heneratgoda, with 80 plants of *Taraktogenos Kurzii*, 128 plants of *H. Wightiana* and 50 plants of *H. anthelmintica*. These plants have all been put out 25 feet apart in large holes and were shaded with *Gliricidia maculata*. This shade was considered necessary to protect the young plants from the sun and from wind. It is now being gradually reduced. The soil between the plants has been planted up with a good cover of Vigna (*Dolichos Hosei*) and *Centrosema pubescens* and at Heneratgoda this cover crop has been forked in annually. Growth has been satisfactory that of *Hydnocarpus* being more rapid than that of *Taraktogenos Kurzii*. The tallest plant at Peradeniya was $5\frac{1}{2}$ feet high when 14 months old and the tallest *Hydnocarpus Wightiana* at Heneratgoda was $7\frac{1}{2}$ feet at 12 months and the tallest *Taraktogenos Kurzii* $5\frac{1}{2}$ feet at 22 months from

date of planting. It is expected that seedling plants—such as these areas are composed of—will fruit in 8-10 years, but it has been decided to test whether budded or grafted plants will produce fruit at an earlier date and experiments are shortly to be begun to test:—

Budding:

6 plants each of *H. anthelmintica* on *H. Wightiana*, *H. heterophylla* and *H. venenata*.

6 plants each of *H. Wightiana* on *H. anthelmintica*, *H. heterophylla* on *H. Woodii* and *H. venenata*.

and at Heneratgoda 6 plants of *H. Wightiana* on *H. venenata*. Grafting by approach similar to the grafting practised for mango grafting:

6 plants of *H. anthelmintica* on *H. Wightiana* and on *H. venenata*.

6 plants of *H. Wightiana* on *H. anthelmintica* and on *H. venenata*.

Two estates have also taken up the question of the cultivation of *H. Wightiana* and seed have been imported and plants raised in the nurseries of the Royal Botanic Gardens, Peradeniya, for these undertakings.

Tests of Oils of Local Species.

In the previous report reference was made as to the desirability of testing the oils secured from the local species of *Hydnocarpus*. Samples were sent to the Imperial Institute, London, and the reports received have been as follows:—

"Investigation of the Oils of Hydnocarpus Spp. from Ceylon.

Preliminary Statement.

The samples of seeds of *Hydnocarpus octandra, H. alpina* and *H. venenata* from Ceylon have been examined with the following results:—

	H. octandra.	H. alpina.	H. venenata.		
			Present sample.	Brill (7)	Perkine & (5) Cruz.
Average weight of a seed, grm.	1·94	1·83	0·34	——	0·3
Average weight of a kernel, grm.	1·35	0·52	0·21	——	0·15
Composition of Seed.					
Kernels, per cent.	69·6	28·5	62·5	45·6	49·5
Shells, per cent.	30·4	71·5	37·5	54·4	50·5
Kernels.					
Moisture, per cent.	3·8	4·3	4·9	——	2·3
Oil, in kernels, as received per cent.	65·6	62·7	63·7	51·2	59·8
Oil, in moisture-free kernels	68·2	65·5	67·0	——	61·2
Oil.					
Optical Rotation of oil	17°C +54·11°	20°C +47·58°	21°C +53·47°	30°C +52·03°	30°C +46·4°
Optical Rotation of Fatty Acids	18°C +54·03°	18°C +50·2°	22°C +56·19°	—— ——	30°C +49·0
Solidifying point Fatty Acids	°C 48·5	+39·2	47·0	——	47·0

The optical rotation of *H. alpina* oil was found by Wolff and Koldevijn (1) to be + 49·5° and by Lendrich, Koch and Schwarz (2) to be + 49° at 20°C. For the oil of *H. anthelmintica*, Lendrich, Koch and Schwarz (2) reported the optical rotation to be + 51·5° at 20°C. and Power and Barrowcliff (4) found for the oil (a)D + 51·0° and for the fatty acids (a)D + 53·6°.

The fatty acids from the oils prepared from these three samples of *Hydnocarpus* seeds have been submitted at the Imperial Institute to a process of fractional crystallisation and fractional precipitation with barium acetate according to Power and Barrowcliff's method (4). As far as the investigation has proceeded chaulmoogric acid has been isolated from the fatty acids from the oils of *H. octandra* and *H. alpina* but no hydnocarpic acid has yet been obtained from either oil.

As regards the oil of *H. venenata* the fractionation of the fatty acids has not yet reached such a stage as to enable a definite statement to be made.

It seems probable that these three oils contain glycerides of chaulmoogric and hydnocarpic acids as do oils from other Hydnocarpus sp., in view of the fact that they possess high dextrorotatory power.

Further work is proceeding with a view to the isolation and identification of any hydnocarpic acid present.

The following notes on the results of previous investigations of these oils may be of interest.

Hydnocarpus alpina.

Wolff and Koldevijn (1) examined this oil in 1912, determined its constants and found it to be strongly optically active, indicating the presence of glycerides of optically active fatty acids, possibly chaulmoogric or hydnocarpic acids or both. Lendrich, Koch and Schwarz (2) corroborated this and stated that the physiological action of the oil was similar to that of other *Hydnocarpus* fats. Jumelle (3) mentions that the presence of chaulmoogric and hydnocarpic acids is indicated in the mixed fatty acids.

According to the letter (No. A—193), dated 20th September, 1927, from the Director of Agriculture, Ceylon, the sample of seeds forwarded under the name of *H. alpina* may prove to be derived from *H. anthelmintica*.

Power and Barrowcliff (4) have examined the oil from *H. anthelmintica* seeds and proved the presence of the glycerides of chaulmoogric, hydnocarpic oleic, and palmitic acids. Perkins and Cruz (5) investigated the oil from seed grown in Indo-China and also found chaulmoogric and hydnocarpic acids.

Hydnocarpus venenata.

According to Grimme (6) various chemists have investigated the oil of *H. venenata* and have shown it to be optically active. Lendrich, Koch and Schwarz (2) also found this oil to be highly dextrorotatory. Brill (7) proved the presence of chaulmoogric and hydnocarpic acids in the mixed fatty acids from the oil, prepared from seeds obtained from Calcutta.

Hydnocarpus octandra.

No reference to any investigation on this oil has been found.

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7. *Phil. Journ. Sci.* A. 1916, 11, 75.

Final Report from the Imperial Institute Dated June 21st, 1928, on Hydnocarpus Seeds from Ceylon.

"The samples which are the subject of this report were received at the Imperial Institute on the 20th December, 1926, and the 6th September, 1927, and are referred to in letters No. A 193 of the 10th November, 1926, and 8th August, 1927, from the Director of Agriculture.

It was stated that in view of the probable increase in the demand for the oil of Hydnocarpus seeds for the treatment of leprosy, the Department of Agriculture has undertaken the cultivation of *Hydnocarpus Wightiana* in the Botanic Gardens, Heneratgoda, and at the Experiment Station, Peradeniya, and that in this connection it was considered desirable to ascertain the value for this purpose of other species of Hydnocarpus indigenous to Ceylon. It was therefore requested that the present samples, consisting of the seed of *Hydnocarpus alpina* (?), *H. octandra* and *H. venenata*, should be examined to determine whether the oils, like those of *Hydnocarpus wightiana*, contain glycerides of chaulmoogric and hydnocarpic acids.

An interim report on the samples was furnished to the Director of Agriculture by the Imperial Institute on the 26th January, 1928.

Description.

Hydnocarpus alpina (?)* Weight 5¼ lb.

Brown, regularly-shaped seeds, about ¾ inch long and ½ inch in diameter. The seeds had a thick woody shell enclosing a kernel covered with a reddish-brown skin. The kernels were white internally.

Hydnocarpus octandra. Weight 2¾ lb.

Dark brown, irregularly-shaped seeds, from ¾ to 1 inch long and from ½ to ¾ inch in diameter. The seeds had a thin woody shell enclosing a kernel covered with a reddish-brown to brown skin. The kernels were pale yellowish-brown internally they had a rancid odour and many were covered with mould.

Hydnocarpus venenata. Weight 2¾ lb.

Brown, oval seeds, from ½ to ¾ inch long and ⅜ to ½ inch in diameter. The seeds had a thin woody shell, the external surface of which was rough, enclosing a kernel covered with a very thin, papery outer skin, greyish to brownish in colour. The kernels were cream-coloured and soft internally and possessed a rancid odour. About 10 per cent. of the seeds were shrivelled and some of the kernels were discoloured and defective.

Results of Examination.

The oils were prepared from the seeds by extraction with light petroleum and had the following physical characters :—

H. alpina : A cream-coloured hard solid fat.

H. octandra : A creamy-white hard solid fat.

H. venenata : A brownish-cream fairly hard solid fat with a rancid odour.

The seeds and the oils obtained from them were examined with the following results, which in the case of *H. venenata* are shown in comparison with corresponding figures recorded by Brill (Philippine Journal of Science, A. 1926, *11*, 75) and Perkins and Cruz (*loc. cit.* 1923, *23*, 543) :—

* From information furnished by the Director of Agriculture in letter No. A. 193 dated 20th September, 1927, to the Imperial Institute it appears possible that this seed may actually be that of *H. anthelmintica*.

	H. alpina. (?H. anthelmintica).	H. octandra.	H. venenata.		
			Results recorded by		
			Present sample.	Brill.	Perkins and Cruz.
Average weight of Seeds, in grams.	1·83	1·94	0·34	——	0·3
Average weight of kernels, in grams.	0·52	1·35	0·21	——	0·15
Composition of Seed :—					
kernels, per cent.	28·5	69·6	62·5	45·6	49·5
Shells, per cent.	71·5	30·4	37·5	54·4	50·5
Kernels :—					
Moisture, per cent.	4·3	3·8	4·9	——	2·3
Oil, in kernels as received, per cent.	62·7	66·7	63·7	51·2	59·8
Oil, in moisture-free kernels, per cent.	65·5	69·3	67·0	——	61·2
Oil :—					
Optical rotation of oil (in chloroform)	+47·58°* at 20°C	+54·11° at 17°C	+53·47° at 21°C	+52·03° at 30°C	+46·1° at 30°C
Optical rotation of fatty acids (in chloroform)	+50·12° at 18°C	+54·03° at 18°C	+56·19° at 22°C	——	+49·0° at 30°C
Solidifying point of fatty acids	39·2°C	48·5°C	47·0°C	——	47·0°C

The results of the examination show that the oils obtained from the seeds of these three species of Hydnocarpus possess a high dextro-rotatory power, thus resembling other oils of the chaulmoogra and hydnocarpus groups. This property suggests that the oils contain glycerides of chaulmoogric or hydnocarpic acids, or both, and a detailed examination of the fatty acids from the three oils was accordingly made in order to determine their nature.

The fatty acids from the oils were submitted to repeated fractional crystallisation and fractional precipitation with barium acetate according to the method employed by Power and Barrowcliff in their investigations of Hydnocarpus oils (*Journal of the Chemical Society*, 1905, 87, 884). The following results were obtained :—

H. alpina. Fractions of the acids were obtained which melted at 66° to 67·5°C. and had an optical rotation at 13°C of +61·93°. These fractions were white and crystallised in glistening plates.

H. octandra. Fractions were obtained which melted at 66° to 68°C. One of these fractions, melting at 67·5° to 68°C. had an optical rotation of +62·41° at 17·5°C ; it was pale cream and crystallised in glistening plates.

H. venenata. Fractions were obtained melting at 66° to 67·5°C. The main fraction, melting 66°C. had an optical rotation at 13°C. of +57·94° ; it was creamy white and crystallised in glistening plates.

The above results indicate the presence in each oil of chaulmoogric acid (melting point 68°C. and optical rotation +56°) but hydnocarpic acid (melting point 60°C. and optical rotation +68°) was not definitely detected in any of the three oils.

It should be pointed out however that the quantities of the fatty acids available for examination were comparatively small which rendered the fractionation process difficult. In these circumstances it is not desirable to draw the conclusion that hydnocarpic acid is entirely absent in all three cases.

* The optical rotation of *H. alpina* oil was found by Wolff and Koldevijn to be +49·5° and by Lendrich, Koch and Schwarz to be +49° at 20°C.

† For the oil of *H. anthelmintica*, Lendrich, Koch and Schwarz recorded an optical rotation of +51·5° at 20°C. and Power and Barrowcliff found for the oil +51·0° and for the fatty acids +53·6°.

Remarks.

With reference to the results recorded in the present report, the following information may be given regarding previous investigations of the oils.

The oil of *H. alpina* has been examined by Wolff and Koldevijn (1) and by Lendrich, Koch and Schwarz (2) and found to possess strong optical activity, but the nature of the fatty acids present was not determined. The latter investigators stated that the physiological action of the oil was similar to that of other Hydnocarpus fats.

With reference to the possibility that the seed forwarded as *H. alpina* may actually have been derived from *H. anthelmintica* it may be mentioned that Power and Barrowcliff (3) and other investigators have shown that the oil of *H. anthelmintica* seed contains the glycerides of both chaulmoogric and hydnocarpic acids.

No reference to any previous investigation of the oil of *H. octandra* has been found in the available literature.

As regards *H. venenata,* various chemists have investigated the oil of this species and have shown it to be optically active (2), (4), (5) and Brill (6) found both chaulmoogric and hydnocarpic acids in oil prepared from seeds obtained from Calcutta.

References.

1. Pharm. Weekbl. 1912, *49,* 1049, (abst. in *Chem. Centralbl.,* 1913, *84, i,* 31).
2. *Zeitsch. Nahr. und Genussm.,* 1911, *22,* 441, (abst. in *Analyst,* 1912, *37,* 21).
3. *Journ. Chem. Soc.,* 1905, *87,* 884.
4. *Phil. Journ. Sci.,* 1923, *23,* 543.
5. *Chem. Rev. Fett und Harz Ind.,* 1911, *18,* 132.
6. *Phil, Journ. Sci. A.,* 1916, *11,* 75.

Note.—The H. alpina referred to in this report is really *H. anthelmintica*—seed of the tree growing in the Royal Botanic Gardens, Peradeniya.

Samples of seed of *H. venenata* were also sent to the Leprosy Research Laboratory at Calcutta, and the report received was as follows :—

Chemical Examination on oil *Hydnocarpus venenata.*

Shell—21%
Kernel—79%
Oil from seeds—24% by cold expression.
Acid Value—20·5.
Saponification value—212·2.
Iodine value—89·1.
Specific rotation at 20°C. + 58·4.

It is also stated that "the results obtained from the clinical tests of the oil do not appear to differ materially from those following the use of oil from *H. wightiana.*"

From these reports it would appear that the oil of *H. venenata* might be considered to be suitable for the treatment of leprosy, and if local collections could be secured from wild trees the seeds might be used by the Medical Department in Ceylon. From the cultivation point of view, I would not, however, recommend its cultivation, as its fruits and seeds are small, mature with difficulty and are difficult to collect. It could be used for stock on which to bud or graft other large fruited species such as *wightiana* and *anthelmintica*. The first tests of budding have not been successful, but further tests are now in course of being carried out, and there should be little doubt that if budding cannot be performed grafting by approach should be practicable.

Memorandum on a System of Drainage Calculated to Control the Flow of Water on Up-country Estates, with a View to Reducing Soil Erosion to a Minimum.

E. O. FELSINGER,

Proprietor of Primrose Hill, Kandy, and Fruithill, Hatton.

TO my mind there is no topic of such paramount importance to the tropical planter as the question of soil erosion in view of the fact that this phenomenon is to be seen going on year in and year out on Up-country estates from which fine soil material is being steadily washed away into the gullies and streams which run red with what is the very life-blood of the estates. The wonder is that planting practice has not adapted itself to the checking of this depletion of cultivated areas through the removal of the best part of the soil.

Dr. Hill, the Director of Kew, who recently visited the Island, struck rather a dramatic note when he said, "Your Island seems to be steadily washing into the Sea," but he was telling us nothing but the truth. It is only when one realises that this washing away of soil material has been going on for years and decades that one gets a definite idea of the enormous loss which the estates in this Colony have suffered, and in many cases are suffering, without let or hindrance. Loss of soil material means loss of fertility, and fertility cannot be restored except at considerable cost. On the principle that prevention is better than cure the wiser course would, of course, be to prevent loss of fertility by arresting soil erosion than to try and make good the loss that follows. It is not only the more convenient but also the more economical way of meeting the situation.

In recent years the subject of soil erosion has been very much to the fore and a good deal of work of an experimental nature has been carried out by scientific Departments—including those of India and Ceylon—with the object of discovering the best means of preventing it. As a result various methods have been recommended, such as transverse drainage, a more rational system of planting, establishing contour hedges and dykes, terracing hill-sides as far as practicable and so on.

My object is not to discredit any of these methods, each of which has its own merits, but to describe a plan which I have devised and carried out with considerable advantage on my estates at Primrose Hill, Kandy, and Fruit Hill, Hatton.

It has been said that many of the methods suggested for preventing erosion are only practicable on new clearings, and that their introduction into existing estates would tend to disorganise the regular work, but my method of controlling the water flowing over the land could easily be adopted at any stage in the life of the plantation. It is as simple as it is efficacious, and calculated to retain both silt and moisture and put a stop to the disastrous scouring which gives rise to gaping, crevasse-like fissures formed by the head-long, uncontrolled rush of water down a hillside.

Having for the past 20 years had to do with the working of estates in the low country where natural conditions are such as do not bring this question of erosion prominently before the planter, I was not a little shocked when I discovered what was going on during rainy weather on an Up-country estate of mine. The facilities which I found existed for denudation struck me as something that called for immediate action since I felt that no resourceful man should countenance a practice which amounted to bringing the soil of an estate into the best possible condition through tillage and manuring only to let this soil be carried away into the drains and ultimately off the land.

Even though a practice has been crystallised by custom, received the sanction of long usage and acquired a sort of prescriptive right to be accepted of all men, one must not hesitate to abandon it if one is firmly convinced that it is unsound in principle. It is up to the practical-minded man to critically scrutinize methods which have come down to him from others who had not the same opportunities for judging of their merits as himself.

The loose surface layer of a cultivated area is indeed the very cream of the soil, and to allow it to be washed away must be reckoned as an unpardonable offence in agriculture. Experiments made by the Department of Agriculture at Peradeniya went to show that in a year about ·17 acre inches of top soil had been lost by erosion, but on the steep Up-country hillsides where the rainfall is abnormally high the loss must be very much greater.

My idea was as far as possible to trap the soil that was being carried away by storm-water, by providing a series of locks or barriers or dams as impediments to the gravitation flow of water so that its force as it travels along the drains may receive a shock on meeting with each obstacle in its path and lead to a deposit of the silt that was being carried in suspension.

I ought to state that it was Mr. Gaddum of Ambawela, Gampola, who induced me to write this memorandum about my

Plan to Show Differences in Methods.

system of drainage or rather water-control. He himself has tested it and found it satisfactory. I quote as follows from a letter which Mr. Gaddum wrote to me under date 21st of April this year.

"I am writing to you at the suggestion of Mr. D. S. Cameron, my Visiting Agent, in connection with a system of draining originated by you. When he last visited me on March 29th, Mr. Cameron showed me by means of a rough sketch how you deepened your old drains and converted them into a series of water-holding "Locks" and the idea appealed to me so greatly that I went into the matter fairly thoroughly and compiled a few facts and figures. Mr. Cameron referred me to you as he said he had first seen this work done on Fruit Hill. I am opening a fairly large area in tea this year and I am cutting all my new drains on your system which so far has proved remarkably efficient; in fact in one small area I think that I have saved already approximately 50 tons of silt an acre incredible though this may sound and I feel that the idea is of such agricultural value that it ought to be published especially at the present time when the subject of soil conservation is receiving so much attention.

This letter is written in the hope that you will publish your scheme."

In the rough sketch A which accompanies this paper the upper portion lying above the road is intended to show the conditions usually to be found on estates with self-formed runnels that tend to eat into the land. A specially constructed stone spill is seen at the junction of the main drain (neththi kanu) with the road. It is part of the new system and is so designed as to adapt itself to the downward rush of water and break its force without proving too great an obstacle and providing too sudden a check to the flow. The lower part of the sketch illustrates the new system of draining with the dams and spills provided at intervals as designed by me and adopted on Primrose Hill. These dams may be part of the original cutting left behind, or mounds of earth reinforced by stones to give them greater stability. The spills are specially designed to carry off the overflow. They may vary from 2½ to 4 inches below the land surface according to varying natural conditions. In addition to the saving of silt thus effected as shown below, the water retained in the drain percolates through the soil and thus provides moisture to the tea. The Diagrams B 1, B 2 and B 3 hereto annexed show sectional drawings of the drains or channels which explain themselves.

In an acre of land about 32 cross-channels can be cut 15 to 25 feet apart according as space permits, or on an average 20 feet distant from each other. This is after allowing 1½ feet as width of each channel.

If these channels are broken up by dams at, say, $10\frac{1}{2}$ feet intervals, there will be, allowing for $1\frac{1}{2}$ feet as the length of each dam, 5 intervening pockets per channel for the deposit of silt, or 160 to the acre.

If silt accumulates in each pocket to a height ranging from 1 inch to 11 inches, or an average height of 6 inches or $\frac{1}{2}$ a foot, and the width of the channel is $1\frac{1}{2}$ feet, each pocket or drain will contain $10\frac{1}{2}$ feet by $1\frac{1}{2}$ feet by $\frac{1}{2}$ foot or about 8 cubic feet of silt. This works out at about 1,280 cubic feet to the acre.

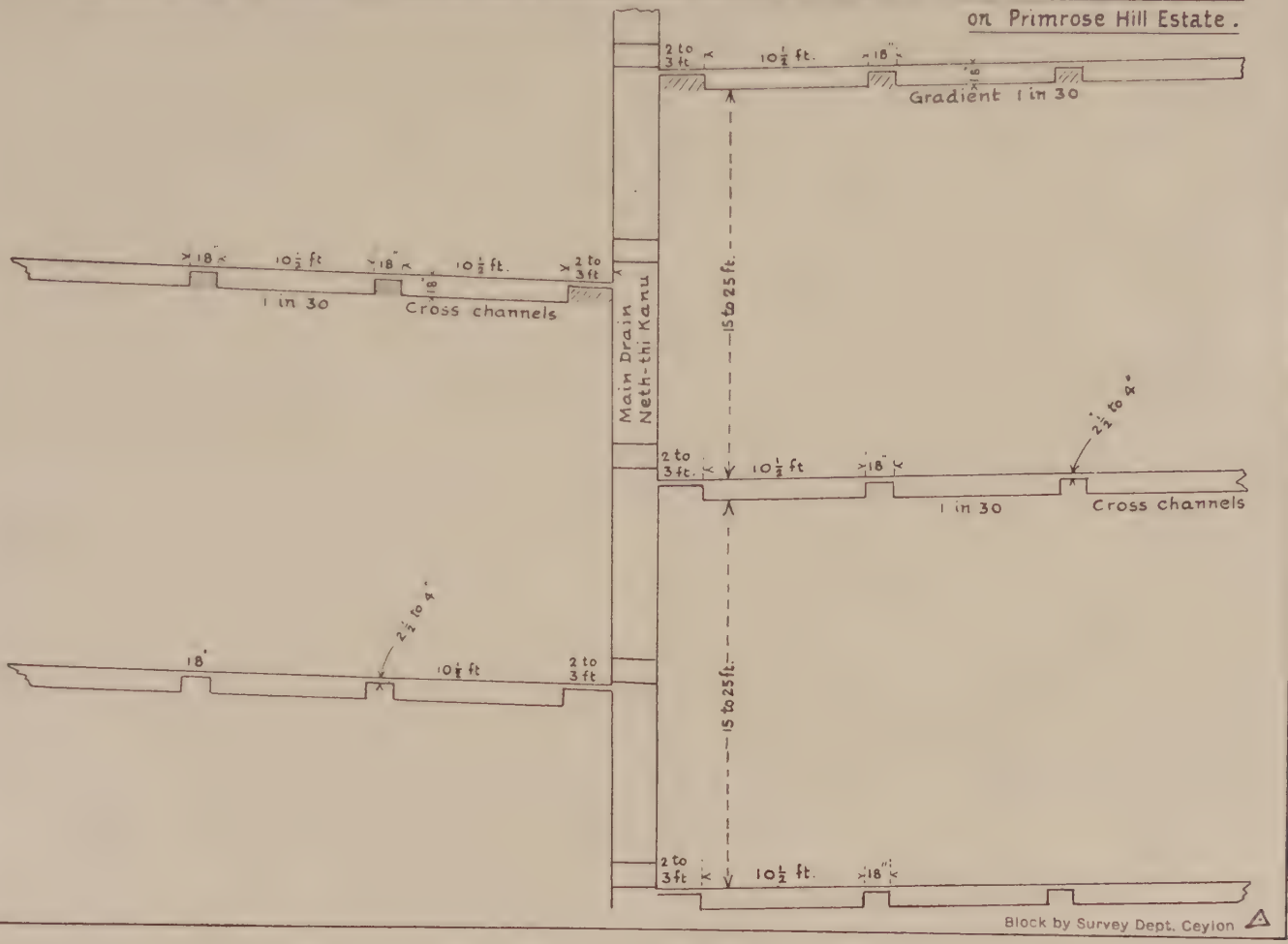
Taking the weight of average estate soil at 92 lb. per cubic foot, the weight of locked silt per acre will be about 92 x 1,280 = 117,660 lb. or 50 tons—no small gain.

In a new clearing a large part of this silt could be utilized to refill the holes dug for the plants in place of the surface soil now generally used.

The actual saving will depend on many factors such as slope land, gradient of drains, number of dams, height of clearance above spill-level, &c. The figures given in Diagram B 3 should suit the requirements of old existing estates. The contributory drains should be provided with dams and spills at intervals of 6 feet or more according to the gradient. Those of the main drains are so constructed as to stand a heavy down flow being curved inwards as shown in the sketch A. Diagram B 2 represents conditions better suited to a new clearing.

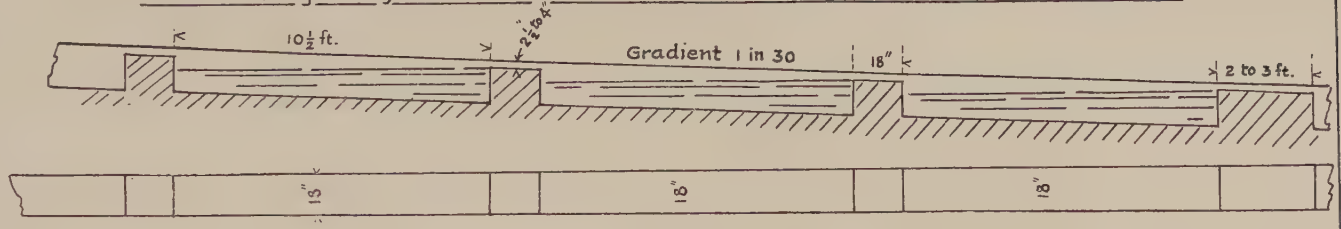
I am aware that the construction of silt pits has been recommended by the Department of Agriculture and that these have been adopted and found to be of considerable value. But I am convinced that my plan, which is practically the reverse of the silt pit system, is the better. In the silt pit system in addition to the drain, a pit has to be dug at intervals whereas in the system which I adopt not only is the labour of digging a pit obviated but there is a further saving of labour as a portion of the drain is left uncut at intervals to serve as the lock. I submit my system with all deference to the planting community and hope the result will justify its adoption.

Mr. E. O. Felsinger's System of Prevention of Soil Erosion & Conservation of Moisture as practised by him on Primrose Hill Estate.



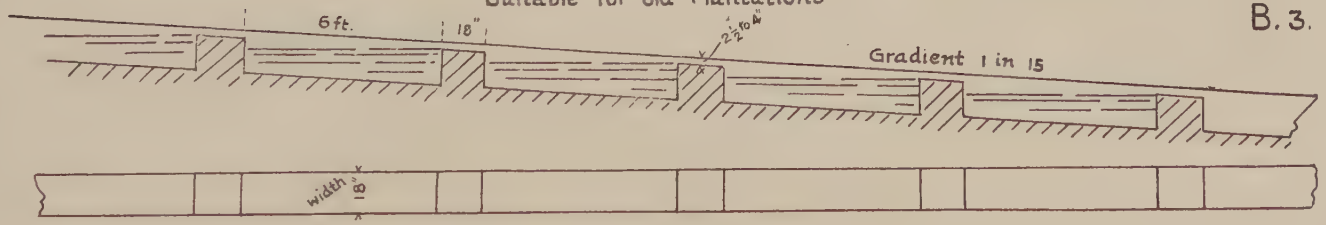
Suitable for a new clearing for tea. B.2.

Mr. E.O. Felsinger's System of Prevention of Soil Erosion & Conservation of Moisture.

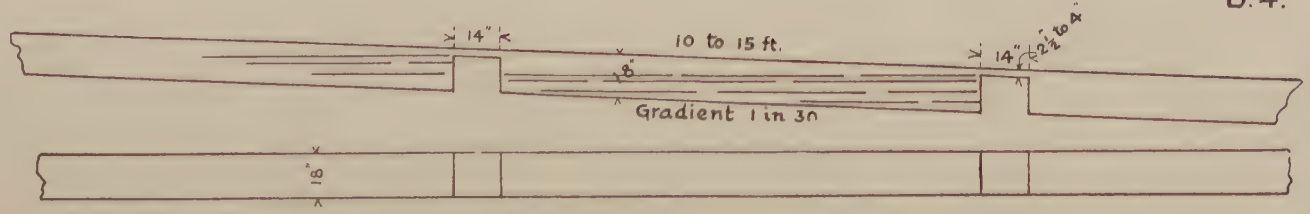


Suitable for old Plantations

B.3.



B.4.



Block by Survey Dept. Ceylon.

A

Mycological Notes (16).

The Parasitism of *Rhizoctonia bataticola* (Taub.) Butler and other Fungi.

W. SMALL, M.B.E., M.A., B.Sc., Ph.D., F.L.S.

Mycologist, Department of Agriculture, Ceylon.

THE writer's work on the fungus causes of root disease of woody plants in Uganda and Ceylon has led to two conclusions, (1) that *Rhizoctonia bataticola*, a soil-inhabiting sclerotial fungus, is a cause of root disease, that is to say, that the fungus is able to attack and kill plants exposed to it in the soil and is therefore a parasite, and (2) that, when it is found in the company of another fungus (or fungi) in cases of root disease, it precedes the other form (or forms) in time of attack and is therefore primarily responsible for disease. Those views were published in 1927 (1), and the facts which supported them and the circumstances which led up to them were duly discussed. They have been criticised from two points of view, (1) that *Rhizoctonia* is a saprophytic form and is entirely incapable of parasitism, and (2) that the parasitism of *Rhizoctonia* is dependent to such a degree upon the presence of preliminary or contributory conditions which affect the host plant adversely before attack takes place that the fungus may be regarded as a weak parasite or one that is harmless in the absence of the contributory conditions.

The second view which, be it noted, does not deny the parasitism of *Rhizoctonia* but makes it conditional on circumstances unfavourable to the host plant is held in the West Indies and will be answered in another place to the effect that contributory conditions are not apparent in the field in Ceylon and have not been found to be essential in successful *Rhizoctonia* infection experiments. The first view is held in Ceylon by Gadd and Petch who deny that *Rhizoctonia* can be parasitic under any circumstances and assert that it is only and always a common soil saprophyte. They make no mention of, and presumably do not

admit, the possibility of facultative parasitism on the part of *Rhizoctonia*. In other words, their view of *Rhizoctonia* means that they consider that the fungus lives upon or obtains its food materials from dead matter only and that it cannot and never does live on or in living tissues. The writer's point of view is opposed to that of Gadd and Petch; it regards *Rhizoctonia* as a parasite in its relationship to living plants and as having none of the attributes of a true saprophyte. The present note deals with the views of Gadd and Petch only, and in particular is a reply to the remarks made by the latter at the Agricultural Conference held at Peradeniya in May, 1928 (2). It shows that there is reason why the views of Gadd and Petch may be rejected.

Gadd (3) put forward the saprophytic view in 1927, and, in reply to his criticism, the writer (4) drew attention to the sole association of *Rhizoctonia* with numerous cases of root disease of woody plants and to the circumstances of its occurrence in nature which pointed strongly to parasitism. With reference to the writer's doubt concerning the parasitism of other root fungi like *Poria* and *Fomes*, Gadd held that their parasitism was proved by the supposed successful control of their activities by trenching and stumping. It had to be pointed out (4), therefore, that there was no proved cause-and-effect connection between treatment of root disease by trenching and stumping and a supposed diminution in the amount of root disease in Ceylon, that the success claimed for trenching and stumping might be doubted and that the supposed diminution of root disease might be questioned. Gadd ignored *Rhizoctonia* infections of woody seedlings obtained by the writer in Uganda (5), and he has not yet offered proof of the complete saprophytism he claims for the fungus in nature. It may be added that *Rhizoctonia* does not behave as a saprophyte in the field in the sense that it may be found on any medium convenient for its growth, for example, woody debris or the dying or dead roots of trees that have been cut down in areas of soil known to contain *Rhizoctonia*, nor is it by any means confined to the dead matter or substrata affected by the true saprophyte.

It may be of interest to consider the points brought forward by Petch (2) against the parasitism of *Rhizoctonia*. In saying that there is no evidence that *Rhizoctonia bataticola* can be parasitic on woody plants, he also ignores the results reported by the writer (5) in 1926 and the later statement (6) that results had been attained at Peradeniya. It has been shown that *Rhizoctonia* can attack and kill seedlings of tea, rubber, cacao, lime and dadap, and other infections have been obtained on plantains and young coconuts. An account of the experiments and the results will be published elsewhere. Further, Petch follows Gadd in ignoring the significance of cases of sole asso-

ciation of *Rhizoctonia* with root disease. It would be interesting to know how he would explain occurrences of *Rhizoctonia* on tea in which no other root disease fungus is present and in which penetration by *Rhizoctonia* from the smallest roots through the larger roots and even into the stem is distinctly set forth and is followed by death of the plant. In such cases, and they are not uncommon, the death of the plant may be attributed to *Rhizoctonia* with reason and certainly with as much reason as Petch attributes pathogenicity to *Poria* and *Diplodia*. If not, Petch would apply to *Rhizoctonia* tests or citeria of pathogenicity which he has not applied to certain fungi which he lists as causes of root disease of tea, a proceeding that is somewhat one-sided. The conclusion seems unavoidable that, if he had detected its association with, for example, root disease of tea, Petch would have included *Rhizoctonia* among the fungi to which he attributes root disease of tea without having tested in experiment their ability to cause root disease. Gadd (7), again, has said that "there is no obvious "reason why the mere presence of the fungus should suggest a "parasitic habit," a remark which shows that he also judges *Rhizoctonia* by standards which he does not apply to other supposed parasitic fungi.

Two further points are contained in the following sentence: "If a root attacked by *Fomes* is buried in contact with the roots "of a rubber tree, it is more than even chance that the tree "will be attacked by *Fomes* and die. That cannot be done with "*Rhizoctonia bataticola*." The first point is that the claim cannot be admitted because experiments conducted at Peradeniya within the last two years have failed to show that *Fomes* will spread to and attack rubber roots alongside which it is buried, and the second is that the words "That cannot be done with *Rhizoctonia* "*bataticola*" are meaningless because *Rhizoctonia* does not and has never been asserted to spread by contact or attack woody roots through the bark. In saying, therefore, that the chances of parasitism in fungi like *Fomes* and *Poria* are mathematically greater than those of *Rhizoctonia* he ignores the fact that the number of possible points of entry for *Rhizoctonia*, that is, the feeding roots, is at least as great as, if not much greater than, the points open to the attack of *Fomes* or *Poria*, that is, the surfaces of the larger roots. A calculation regarding a method of infection which is not adopted by the fungus in question is of no value. Besides, it takes no note of the possibility that a fungus may be more strongly parasitic than another with which it is compared. It may be added that the simple demonstration of the parasitism of *Poria* recommended by Petch has not been found to succeed in recent trials with healthy tea bushes. *Poria*, like *Fomes*, cannot therefore be regarded by the writer as a primarily parasitic fungus.

Petch's arguments for the saprophytism of *Rhizoctonia* do not bear scrutiny. The first, that the fungus has not been made to attack woody plants, has already been answered. The second is that it is found in dead roots of plants of all kinds. It may have been forgotten that a supposed root disease fungus, that of brown root, has been recorded in Ceylon as a cause of disease of over twenty plants. The argument may therefore be applied equally to *Fomes lamaoensis*. If emphasis is meant to be laid upon the words "of all kinds," it can be said that there is no reason why the fact that a certain fungus may be found on the roots of many different plants should not mean that it is capable of attacking and killing monocotyledons as well as dicotyledons and gymnosperms. Further, Petch does not take into account the most significant fact of all, that *Rhizoctonia* can be found in *living*, apparently healthy, large roots as well as in those it has killed, although the fact was brought to his notice (6). Another argument for its saprophytism is that *Rhizoctonia* grows rapidly in culture. Petch appears to be unaware of the fact that all isolations of *Rhizoctonia* do not grow rapidly in culture, and he implies that all fungi which grow rapidly in culture are to be regarded as saprophytes, a view that only requires to be put forward to be rejected. It cannot be applied to *Rhizoctonia* and withheld from other parasitic fungi. It is well known that many parasitic fungi are capable of vigorous growth in artificial culture. These criticisms show that Petch's arguments for the saprophytism and against the parasitism of *Rhizoctonia* cannot be accepted.

A further point is that quick action on the part of *Rhizoctonia* when inoculated into wounded jute stems proves it to be a rapid grower, an argument that ignores the fact that any fungus will prove to be a rapid grower on a medium to its liking. Growing *Rhizoctonia* on the wounded stems of jute, a plant part that is susceptible to *Rhizoctonia*, is almost comparable to growing it in a culture medium or on blocks of wood. A truer and fairer comparison would have considered the rate of growth in healthy roots, not in wounded stems, and it would show that the rate of advance is slow. The latter fact, however, is no argument in favour of saprophytism or against parasitism. Petch requires *Rhizoctonia* to be a rapid grower in order that it may be fitted into the hypothesis which regards *Rhizoctonia* as able to enter and advance in the roots only after they have been presumed to be killed by the attack of fungi like *Fomes* and *Poria* at a higher point or by some other agency. He takes no account of the many cases in which *Fomes* or *Poria* or an outside agent is absent and *Rhizoctonia* nevertheless has penetrated the roots with thoroughness, or of the numerous cases in which attack of *Fomes* or *Poria* on larger parts of roots is only in its initial stages while *Rhizoctonia* attack has killed the smallest roots extensively and often

also the larger roots, that is, cases in which there is no question of the advance of *Rhizoctonia* in roots killed or injured by another fungus even though the other fungus be present. Petch would have difficulty in explaining the presence of *Rhizoctonia* in such cases and also the fact that the attack of *Fomes* and *Poria* is confined to roots or parts affected at lower points by *Rhizoctonia* and the further fact that *Fomes* and *Poria* may not appear at all whereas *Rhizoctonia* is always present. In other words, it is to be noted that *Rhizoctonia* attack takes place in the absence of the conditions which are said to be necessary for it. This point brings the argument back to the denial by Gadd and Petch that any meaning may be attached to the sole association of *Rhizoctonia* with cases of root disease and shows how illogical and unreasonable their attitude is.

Gadd (7) has postulated the ability of *Rhizoctonia* to invade dead plant tissues with rapidity, an ability which he requires in order to explain the presence of *Rhizoctonia* at points well-removed from its point of entry, that is, its presence in larger roots into which it has advanced from the smaller parts. As there is no proof or evidence that *Rhizoctonia* can or does enter dead roots and grow in them rapidly or otherwise under natural conditions, Gadd's postulate is founded entirely upon supposition. The only dead roots in which *Rhizoctonia* is found are those killed by itself which remain attached to the plant until natural decay sets in, and there is no doubt that the growth of *Rhizoctonia* under natural conditions is dependent on living root tissues as far as its relation to plants is concerned. At the same time, attention may be drawn again to the fact that *Rhizoctonia* can be found in and isolated from *living*, apparently healthy roots of tea and rubber, which fact is strong evidence against its supposed saprophytism and in favour of its parasitism. The fungus can also be isolated with ease from its advancing edge in roots that are sickly but not moribund or dead. Further evidence for parasitism can be obtained from infection experiments with woody seedlings which will show the entrance of *Rhizoctonia* by the feeding rootlets and the slow advance of the fungus in the roots (or a portion of them) leading to sickness and eventual death of the invaded plant.

The position of Gadd and Petch with regard to their view of *Rhizoctonia* is unsound because it is founded entirely on supposition which can be criticised and swept aside and is backed by their refusal to face the significance of the sole association of *Rhizoctonia* with cases of root disease. They claim saprophytism where none of the conditions of saprophytism are fulfilled, where, on the contrary, it can be shown that the supposed saprophytic fungus cannot possibly be a saprophyte. Their other supposed

strong point, that *Rhizoctonia* has not been proved to be parasitic in experiment, is tenable no longer. The facts point conclusively to the parasitic nature of *Rhizoctonia*.

Gadd (7) has also discussed the significance of the mycorrhizal form of *Rhizoctonia bataticola* found on tea and described by Park (8). His remark that "a mycorrhizal fungus normally plays "no part in causing the death of the plant it inhabits" will not meet with general acceptance for certain authorities hold that the mycorrhizal condition is one of parasitism of the fungus on the plant root, and, when he says that the mycorrhizal theory fits the observed facts "and accounts for the presence of *Rhizoctonia* "in dead roots, particularly the finer roots," he supposes the roots to have been killed by another agent than *Rhizoctonia*, a supposition to which objections have been raised. He makes no allowance, of course, for the possibility that *Rhizoctonia* may have advanced from the mycorrhizal form and killed the roots, and he also fails to account for its presence in large roots well-removed from the original mycorrhizal site, large roots which, be it noted need not be dead. The mycorrhizal theory, therefore, does not fit, as he asserts, the observed facts and is not "entirely opposed "to the parasitic theory." His attempt to explain the advance of *Rhizoctonia* from the mycorrhizal condition to the parasitic on the ground that conditions upset the equilibrium between plant and fungus depends upon proof of the existence and action of conditions unfavourable to the plant. At the moment he merely supposes them to be in action because it is convenient to do so. It may be hoped that the conditions exist; they are not apparent in the field or necessary for the parasitism of *Rhizoctonia* in experiment. In any case, with or without conditions, *Rhizoctonia* would still have to be regarded as a parasitic fungus. The suggestion that *Rhizoctonia* may be enabled to pass from the endophytic or mycorrhizal form to that found in larger roots, particularly larger dead or diseased roots, when the plant is attacked at a higher point by another fungus, for example, *Poria* or is upset physiologically by external conditions was made by Park (8). He was careful to point out, however, that he had little evidence in support of it. The following points militate against the suggestion. It fails to account for the advance of *Rhizoctonia* in the absence of attack by another fungus or in the case of attack which is in an early stage while *Rhizoctonia* has advanced a long way or in the case of attack at a certain point which cannot influence the advance of *Rhizoctonia* at other points. It is not proved that the other fungus can attack independently, or that *Rhizoctonia* is unable to make progress until the other fungus has attacked, and, as pointed out above, adverse external conditions are not clearly in evidence. In any case, *Rhizoctonia* entry into the roots is still prior to the supposed attack of a fungus like *Poria*.

Speculations of this nature, however, have little value in the present state of our knowledge. Before they can be of real help, investigation will have to show if the mycorrhiza is obligate and lasting, that is to say, whether it is a true mycorrhiza. In other words, synthesis of the mycorrhiza should be attempted. A true mycorrhiza need not be of benefit to the plant, and it must therefore be shown whether *Rhizoctonia* is harmful in the mycorrhizal stage. The percentage of roots which harbour the endophytic form and the possibility of the presence of other fungi must also be investigated, and the conditions, not necessarily conditions of external origin, under which *Rhizoctonia* passes from the mycorrhizal stage to that of advance in the roots must be studied.

In bringing forward the question of the *Rhizoctonia* endophyte of tea roots, the writer (6) merely wished to draw attention to the possible significance of the identity of the endophytic or mycorrhizal fungus with that which causes root disease and death and to point out that the present balance of evidence is in favour of the view that the fungus is, as it were, intent on parasitism *ab initio*. It is possible that the mycorrhizal and parasitic forms of *Rhizoctonia* are unrelated as far as subsequent root disease is concerned; it is equally possible that the mycorrhizal condition is a phase, perhaps obligatory perhaps fortuitous, in the causation of root disease by *Rhizoctonia bataticola*. However that may be, the lines upon which investigation of root disease is proceeding seem more likely to lead to a true understanding of the causation of root disease than past investigation which ceased at the point where it first found a possible cause, that is, the larger parts of roots, and was unaware of the necessity for examination of the smaller roots and the feeding rootlets. It thus made the mistake of regarding the agents of root disease which attack at higher points as symptomatic of a first or primary phase of root disease whereas they are more likely to belong to a secondary phase.

Two recent publications which have a bearing on the subject under discussion may be mentioned here. The first is an account by O'Brien and M'Naughton (9) of an investigation into the widespread strawberry disease known as Lanarkshire disease. They describe the invasion of strawberry roots by a mycorrhizal or endophytic fungus which resembles the mycorrhizal *Rhizoctonia* of tea isolated by Park and shown to be *Rhizoctonia bataticola*, and their observations lead them to conclude that the fungus is parasitic and responsible for the disease. It is noteworthy that the disease is reported to be slow-acting and chronic in nature and that the fungus is capable of causing death. It is said that "the ultimate damage "is greater or less as mycorrhizal attack is severe or slight

"and as conditions are unfavourable or favourable for plant "growth." The case differs from that of *Rhizoctonia* on woody plants in Ceylon inasmuch as very large areas are affected whereas *Rhizoctonia* root disease affects scattered plants or small areas, and the difference points to the probability that the action of external conditions over large areas, the manner in which they may be expected to act, has an influence on the amount of disease. It should be noted, however, that external conditions have not been proved to be of primary importance in relation to the root *Rhizoctonia* of strawberry. In fact, O'Brien and M'Naughton remark that "there was abundant evidence to show that the "disease might be serious even on good soils, liberally manured "and well-drained."

The second concerns endophytic fungi of the roots of sugar-cane. Ciferri (10) reports from the Dominican Republic that the endophytes lead to retardation and death of rootlets, that is to say, that the endophytes are parasitic. A species of *Rhizoctonia* is regularly present and is more aggressive and penetrative than a second form which is also found. The evidence for the parasitism of *Rhizoctonia* is considerable. It may be added that the rootlets of tea seedlings infected by *Rhizoctonia bataticola* in the writer's experiments do not show the persistence of a mycorrhizal condition of *Rhizoctonia* in the roots. If it formed a stage in the process of infection, it has been left behind, as it were, by the advance of the fungus; there is morphological evidence of its presence. It should be noted that it is not assumed that the Rhizoctonias of tea, of strawberry and of sugar-cane are the same species. Attention is merely drawn to the trend of investigation, to the recognition of the parasitism of the genus *Rhizoctonia* in small roots without the aid of contributory conditions, and to the fact that the findings of other workers tend to support the writer's conclusions regarding the parasitism of, and the method of attack adopted by, *Rhizoctonia bataticola* in Ceylon.

Up to this point the arguments for and against the parasitism of *Rhizoctonia* have been surveyed and the mycorrhizal condition of the fungus has been discussed. It remains to make a few remarks concerning the position of the fungi which have been regarded in the past as causes of root disease. Their parasitic status has been questioned by the writer on the grounds that they do not occur in nature without *Rhizoctonia* and that *Rhizoctonia* attack takes place prior to the appearance of the other fungus (or fungi) and therefore leads to it. The questioning of their status has led to experimental work on their parasitism and also to the bringing forward of evidence in favour of their supposed parasitism. That the evidence cannot be accepted is apparent from the notes which follow.

Petch (11) has collected the experimental evidence in favour of the parasitism of the old-established and well-known root fungi and Gadd (12) has reported successful inoculations with and infection of tea seedlings by a species of *Rosellinia*. The nature of Petch's evidence for the parasitism of *Poria* and the fungus of brown root disease cannot be regarded as satisfactory. Other cases quoted by Petch seem perfectly good until it is remembered that *Rhizoctonia* is found to be present so consistently in cases of supposed *Poria* and other root disease that suspicion of its undetected presence in the cases quoted is justified and well-founded. In the past *Rhizoctonia* was not looked for or suspected to be present because investigation had not disclosed its presence. It is therefore possible, even likely, that the cases quoted by Petch are not as reliable as they seem. Further, Petch omits to mention in his invitation to planters to experiment with certain root fungi the probability of the presence and influence of *Rhizoctonia* and the necessity for making certain that *Rhizoctonia* is not concerned vitally in what are supposed and meant to be simple one-fungus experiments with *Fomes* and *Poria*. Again, *Fomes*, *Poria* and other root fungi have been used in experiment at Peradeniya in the manner suggested by Petch. The promised results have not been obtained; in fact, it has been shown that *Fomes lignosus* and *Poria* are parasitic only in the presence of *Rhizoctonia*, the former on rubber seedlings and the latter on tea bushes. It may be added that field experiments with the brown root fungus (*Fomes lamaoensis*), *Ustulina* and *Diplodia* have given negative results.

Gadd (13) has said that "the majority of the fungi which "cause root diseases of mature tea appear to be incapable of "attacking seedlings," and he suggests that tea seedlings "are "immune to these fungi (*Poria*, *Ustulina* and *Fomes lamaoensis*) "until they have reached a suitable stage of development." The fungi in question have still to be proved capable of causing of their own efforts root disease of mature tea, and it may be suggested that they do not attack seedlings in nurseries because they may be absent from the carefully-prepared soil of nursery beds or because they are incapable of attacking as primary parasites. It is to be noted that *Poria* and *Fomes lamaoensis* can be found on young tea and other plants attacked by *Rhizoctonia* in the field very soon after planting out. If Gadd has conducted experiments with *Fomes* and *Poria* on seedlings, it would be of interest to have an account of his results. Successful inoculations of tea seedlings with *Rosellinia arcuata*, a fungus which is, on the whole, uncommon, have led Gadd to conclude that "a "pathogenic soil fungus can easily gain entrance into its host by "other ways than viâ the fine rootlets." If this statement is meant to include soil fungi like *Poria* and others, the pathogenicity of

which has not been proved, it is more sweeping than justifiable; it may not be applicable, in any case, to adult bushes since Gadd would make a distinction between the susceptibility of seedlings and that of adult plants. *Rosellinia arcuata* may be the virulent parasite that Gadd reports, but it is uncommon enough to be of very little account. So far as the writer's hypothesis of the secondry nature of *Fomes*, *Poria*, *Ustulina*, *Diplodia* and *Rosellinia* is concerned, it may be necessary to withdraw the relationship of *Rosellinia arcuata* to tea from the list, but, on the other hand, it is important to note that the few cases of *Rosellinia arcuata* on tea that have come into the writer's hands have also shown the presence of *Rhizoctonia*. Further, the writer's experiments with *Rosellinia arcuata* in the field have given negative results. In any case, absolute truth of the hypothesis regarding the secondary nature of *Fomes*, *Poria*, *Ustulina*, *Diplodia* and *Rosellinia* is perhaps too much to expect. The hypothesis, however, is shown by experimental results to be tenable as a whole, and the fact that a small part of it appears to be contradictory to the general conclusion need not invalidate the whole hypothesis.

A few notes on *Armillaria*, *Fomes lamaoensis* and *Diplodia* may be of interest. With reference to *Armillaria* root disease of tea, Gadd (13) who has lately recorded the fungus remarks that "the parasitism of *Armillaria mellea* has been well proved elsewhere." This statement is open to doubt for there seems to be a lack of clear experimental evidence for an aggressive parasitism on the part of *Armillaria* under natural conditions. W. R. Day (14), a recent worker with *Armillaria mellea* (which is probably the same species as that found on tea), says that "the conclusion "to be drawn from the evidence put forward is that *Armillaria* "*mellea* is able to penetrate an uninjured and apparently healthy "host. Accordingly it might appear that the fungus is a virulent "parasite and a primary cause of disease. This is by no means "certain, however, if for one reason only, and that because it is "possible sometimes to find trees that are attacked by the fungus "and yet do not die, or that, belonging to a species reckoned to be "susceptible, are in close proximity to the parasite and yet show "no signs of successful attack." Day's general conclusion is that "other and external factors often, and perhaps always, have a "much greater influence in determining the intensity of infection "and the general susceptibility of species." These words are significant. Although out of place, the suggestion may be made that an examination of the smaller and the feeding roots of trees attacked by *Armillaria* might shed light on the question of the factors that lead to *Armillaria* attack.

Hansford (15) who has been studying root disease in Uganda makes the following remarks on the subject of the brown root disease fungus and *Armillaria* which he found to accompany *Rhizoctonia* in cases of root disease of robusta coffee. "In most "of these instances, but by no means in every case, the original "*Rhizoctonia* has been followed by other fungi among which the "characteristic rhizomorphs of *Armillaria mellea* and the mycelium "of *Fomes lamaoensis* have been noted. The latter fungus, des- "cribed in the East as the cause of brown root disease of various "trees, was definitely a secondary parasite in the case of diseased "coffee in the Sesse Islands. In one native plot of *Coffea robusta*, "every stage in the disease was found, commencing with the "original attack of *Rhizoctonia* on the small rootlets, afterwards "passing along to some of the main roots nearest the surface of "the soil, and finally marked by rapid development of the brown "mycelium of the *Fomes* with its adhering soil and gravel over the "whole of the larger roots of the trees. In other cases the rhizo- "morphs of *Armillaria* were noted as starting on the smaller roots "attacked by *Rhizoctonia* and finally progressing beyond the limits "of invasion of this fungus to the main roots of the tree. In no "case was *Fomes lamaoensis* or *Armillaria mellea* found on coffee "roots in the absence of *Rhizoctonia*, whereas in over seventy-five "per cent. of all cases of root disease *Rhizoctonia bataticola* was "alone present in the attacked roots. This evidence is all in "favour of the contentions of Small that *Rhizoctonia* is the primary "invader in most, if not all, cases of brown root disease and similar "diseases formerly ascribed to fungi of the *Fomes* group." Hansford's evidence supports strongly the writer's contention that the presence of certain fungi is indicative of a secondary phase of root disease, the primary phase of which is caused by *Rhizoctonia*, and it shows that *Armillaria* need not be a primary parasite.

Briton-Jones (16) has reported from the West Indies that "*Fomes lignosus* is not a primary parasite and, if it contributes "at all towards the killing of the plant, it is in the capacity of a "very weak parasite. It is of no consequence whatsoever "from the practical standpoint." He says further that *Fomes lignosus* is one of the commonest fungi to be found in Trinidad, that it is not recorded as a cause of disease in the West Indies, and that, though conditions in Trinidad seem ideal for *Fomes* infection of cacao, it does not occur. Petch (17), however, asserts that the supposed West Indian *Fomes lignosus* is a different fungus from the *Fomes lignosus* of the East. Further comment must be withheld until the question of the identity of the West Indian form is settled.

Experiments at Peradeniya have failed to show that *Diplodia* is the virulent parasite of tea roots described by Petch (18). Gadd (13) may have had a similar experience with the fungus for he now wishes to attribute the association of *Diplodia* with tea root disease and failure to recover from pruning to a weak or secondary parasitism which follows upon and is encouraged by a shortage of food reserves in the affected roots. *Diplodia* may therefore be ignored as a primary cause of tea root disease or failure to recover from pruning, and the true cause of the loss of bushes is to be sought elsewhere, that is, in an inherent or induced inability on the part of the bush to recover from the effects of pruning and plucking. Failure to recover from pruning is regarded by the writer as identical with root disease because it is found that cases of failure to recover from pruning are in reality cases of root disease, and, further, that attack of the fungus *Rhizoctonia bataticola* upon the roots is associated with them. It may be pleaded that *Rhizoctonia* follows the shortage of food reserve in the roots, as *Diplodia* probably does, but it is equally possible that the shortage is caused directly by *Rhizoctonia* attack and advance. It is apparent from the recovery of tea in the field from pruning and from plucking that the effects of these operations alone are unlikely to be the sole cause of a degeneration which results eventually in the loss of the bush and that the presence and operation of another harmful factor are required. The possibility of the action of another harmful agent being aided by the effects of pruning and plucking is always present, but there is no evidence for it, as far as the most likely factor, *Rhizoctonia bataticola*, is concerned. It seems that efforts are being made to treat failure to recover from pruning as a so-called physiological disease before the possibilities of parasitism on the part of a consistently-present fungus are exhausted or even considered, a step that is indefensible when there is evidence of the presence and for the parasitism of the fungus in question.

The matters discussed in the preceding pages may be summarised as follows. It is held by those who oppose the writer's views that the plant in the roots of which *Rhizoctonia* is found must be upset or disturbed by the attack of another fungus (for example, *Fomes* or *Poria*) or by the operation of adverse conditions of growth before *Rhizoctonia* is enabled to attack at all, that the disturbance is complete enough to cause the death of the roots, and that *Rhizoctonia* can enter and occupy only roots killed by such disturbance; in other words, that *Rhizoctonia* can behave only as a saprophyte and never as a parasite. It has been pointed out that these views are founded on supposition and are unsupported by either proof or field evidence. The writer holds,

on the contrary, that the supposed disturbing conditions, physiological or fungus, are neither apparent nor essential for *Rhizoctonia* attack in the field and in experiment, that they have not been shown in operation and are only supposed to be present, that, in general, the other fungi which are said to attack before *Rhizoctonia* have not been proved capable of doing so, that *Rhizoctonia* is found in such positions (for example, living roots) and under such circumstances (for example, sole association) that it cannot be a saprophyte and must be a parasite, and that *Rhizoctonia* has been proved capable of parasitism in experiment.

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Sparrows.

(Passer domesticus and P. domesticus indicus.)

N. K. JARDINE, F.E.S.

Inspector of Plant Pests and Diseases, Central Division.

PASSER domesticus is the common European sparrow, and *P.d. indicus* is the Indian and local form of the same species. There is little difference between the two forms, and the habits are identical.

The sparrow is today a cosmopolitan bird; it is found in every country outside of the artic and antartic circles wherein man dwells, and there are few countries that have not complained against the bird and waged campaigns for its extermination. Ornithological literature shows that nearly every section of the world inhabited by progressive races have cried out against the disastrous activities of the bird. Tegetmeier, the renowned ornithologist, well named the sparrow the "Avian Rat," for in its economic relations the sparrow among birds is comparable to the rat among mammals.

The habits of the Eastern sparrow are identical with those of the European form; in other words, the Indian or local sparrow is equally as destructive as its western cousin. There is nothing to be said in favour of the sparrow. It is true the young are fed on a part diet of insects for the first three weeks of their life, but what little credit may be theirs for this act is counterbalanced by the amount of grain in the milky state, and seed softened by the parents, which is fed to the nestlings.

To its disadvantage may be cited the following facts:—It is cunning, crafty, hardy, aggressive, and a prolific breeder. It destroys fruit, buds and flowers of cultivated trees, shrubs and vines. It devours seeds, nips off tender young vegetables as they develop, it is particularly partial to peas, beans, lettuce and such like garden produce. In the field it damages dry grain crops when newly sown, ripening and when harvested; paddy is heavily attacked when forming in the ear, when ripe and when harvested, and on the threshing floor. It reduces the number of more

attractive and more useful birds such as bulbulls, robins, warblers, wrens, swallows, white-eyes sunbirds, flowerpeckers and swifts, by destroying the eggs and young and by usurping the nesting places. It attacks familiar native birds such as the robins, bulbulls, munias, tits, wrens and sunbirds, causing them to desert their usual haunts. It has no song but is noisy and vituperative. It defiles buildings ornamental trees, vines and shrubs with its excrement and untidy nests. It is recognised the world over as a vagabond, an undesirable, for nowhere is it among the birds that are protected, but to the contrary, for every important state has passed laws for its destruction, but, owing to its hardiness, extraordinary fecundity, diversity of food, aggressive disposition and almost complete immunity from natural enemies through its sagacity and preference for thickly populated communities, it persists as a pest.

In many countries the amount of national loss caused by sparrows, by reason of ravaged crops, has been estimated, and for England alone the sum reaches the appalling figure of $5\frac{1}{2}$ million pounds sterling per annum, and this amount is greater in Canada, Australia and the United States of America.

The sparrow is so great a pest that it is a duty for progressive communities to take steps for its destruction. To do so efficiently it is necessary to know something of its habits.

Nests.—The principal nesting seasons are February to June, but it breeds throughout the year, and there are, as a rule, two broods. The nest is a shapeless untidy mass of straw, grass, fibres, cotton, rags or any such material obtainable; and is lined with soft fabric such as kapok, feathers, cotton wool, etc., and placed anywhere inside (when permitted) or outside of dwellings, in water guttering and down-pipes, niches, in hedges, shrubs, vines and small trees, in bamboo sections, bird boxes and flower and fern pots, and they use nests of other birds; in fact there is no available place around human habitations they will not utilise for nesting if undisturbed. When nests in the making are destroyed in dwellings they will be persistently rebuilt by the birds, time and time again.

Eggs.—The eggs are usually four in number, of a greyish or greenish colour with markings of brown or purple, and are about 20 m.m. long.

Nestlings.—The young are fed on a mixed diet of insects, —usually carterpillars of a hairless nature, grain in the milky state, and seeds softened by the parents. After three weeks the diet is that of the parents.

Habits.—They fly, feed and roost in close flocks. One or more couples will break away from the flock, especially when nesting, and seek congenial grounds around habitations where

they will be tolerated, and soon after these isolated couples are established, the main flock follows. The writer suspects these single pairs to be scouts for the main flock: on three occasions he has allowed a couple to frequent the premises undisturbed, and within a week of each occasion the main flocks, numbering 48, 60 and 230 respectively, have come along and joined the original pair.

Prevention of Increase.—Look for and destroy all nests *that have eggs*. It is next to useless, as a preventive measure, to destroy nests in which the female has not deposited her complement of eggs, for to do so only means that as a nest is destroyed the birds will commence rebuilding, and the repetition of the process is good for neither the patience nor the nerves of the individual. By waiting until the eggs are laid before destroying nests, is an effective measure in that the birds seem to loose heart, and will leave the area.

Methods of Destruction.—(1) By Nests. Supply nesting materials, such as sections of bamboo, boxes, shelters, straw, feathers, wool, etc., etc., for the flock, wait until eggs have been laid, and destroy the lot.

(2) By Baiting.—Tempt the flock to frequent the premises by regularly laying such baits as paddy, bread crumbs, water for drinking and dust for baths. By this method several flocks can be attracted to the area of execution, and the following methods employed to destroy the birds:—

(3) Trapping, by means of shallow boxes or wire frames tilted over the feeding grounds and supported by a stick to which is attached a string ten to twelve yards long, so that the stick may be pulled away by a concealed person, and the box or frame allowed to fall over the birds, which may then be collected, and painlessly and instantaneously killed by throwing against a wall or concrete floor.

(4) Shooting.—Sparrows feed in close flocks and if food is scattered in long narrow belts the whole area may be raked with No. 10 shot, with disastrous results to the pests.

(5) Poisoning.—The most effective poison is strychnia sulphate. It is easily prepared and acts quickly. Needless to say it should not be used where children, animals or fowls can get at the poisoned bait, and it should be used only by those

competent to handle such poisons. The poison is prepared by putting one-eighth of an ounce of strychnia sulphate into $\frac{3}{4}$ of a gill (approximately one teacupful) of hot water and boil until dissolved. Moisten $1\frac{1}{2}$ teaspoonsful of starch with a few drops of cold water, add it to the poison solution, and heat until starch thickens. Pour the solution over one quart of paddy, and stir until each grain is coated. A glass fruit-jar is a good vessel in which to coat the grains, for it is easily shaken and allows of the contents being seen.

The capacity of a sparrow's crop is 30 to 35 grains of husked paddy. Seven to ten poisoned grains will be fatal; less causes paralysis, but the paralyzed birds can be collected and destroyed.

Only as much poisoned grain as is likely to be consumed in a day should be laid out.

A flattish roof is one of the safest places on which to place poisoned grain.

Morning and evening are the best times to lay out poisoned food, as it is at these periods of the day the sparrow consumes the greatest quantity of food at a time.

Poisoned paddy will be harmless after a shower or two of rain.

There is practically no danger of dogs and cats and other animals dying from eating poisoned sparrows.

The husked paddy will be more acceptable as bait than the unhusked grain.

It is advisable to poison and trap at intervals of three and four days, otherwise the birds will become suspicious at so frequent and so many deaths, and will leave the area.

When Miss Eleanor Ormerod published her case against the house sparrow, within a few weeks of its publication 36,000 copies were called for and sent to the chief agricultural centres of the world wherein the sparrow existed, shortly after, the Association of the American Ornithologists gave their collective recommendation that all existing laws protecting the sparrow (at that time comparatively recently introduced into America) should be repealed; clubs for the destruction of the sparrow were organised all over England, followed by active measures against the bird in New Zealand and the various states of Australia, and

Canada. Everywhere Ornithologists, Entomologists and Agriculturists realised the necessity of destroying the sparrow, and laws and regulations were promulgated throughout the civilised world wherein the bird existed. Although the considered opinions of one of the most humane of women and naturalists were accepted all over the universe by those competent to judge the worth or worthlessness of the sparrow, Miss Ormerod was threatened with shooting, hanged in effigy, and suffered many other disagreeable attentions in England. In writing to Tegetmeier, the Ornithologist of world wide reputation, in July, 1897, in reference to collaborating with him in a book on the house sparrow, Miss Ormerod says, "If we could rout *P. domesticus* it would be a national benefit."

The writer is aware that the methods of baiting, trapping and poisoning advocated in this paper is likely to cause distress to those who feel deep sentiment for birds in general and perhaps for the sparrow in particular, but he would emphasize the fact that sparrows are a positive pest to the agriculture of a country, and that they possess no redeeming feature in their habits, and also, that the words of Miss Ormerod apply equally to Ceylon.

Contributions from the
Rubber Research Scheme.

A Note on Cover Crops in Relation to Root Diseases of Rubber.

R. K. S. MURRAY, A.R.C.Sc.

Mycologist, Rubber Research Scheme, Ceylon.

SINCE the introduction of cover crops as a general measure on most Rubber estates in Ceylon, the question has arisen as to how far these crops will favour the spread of root disease.

It is not necessary here to consider in any detail the conflicting views held as to the causation of root disease, but we must at once distinguish between the fungus *Rhizoctonia bataticola* on the one hand, and the fungi commonly associated with root disease such as Fomes (*lignosus* and *lamaoensis*), Poria and Ustulina on the other. Our present knowledge leads us to believe that Rhizoctonia does not spread through the soil by contact, whereas the other fungi do. It would appear, therefore, that the occurrence of the former fungus has no bearing on the present subject except in so far as its presence on a cover plant may be necessary before that plant is attacked by Fomes, Poria, or Ustulina. Rhizoctonia has so far been reported by Small as occurring on *Tephrosia candida*, *Crotalaria* sp. *Desmodium heterocarpum*, and *Clitoria cajanifolia*, of the commonly used covers. Whether the fungi which have in the past been supposed to cause root disease are primarily responsible or not, it seems almost certain that they are at least secondary parasites and hasten the death of the trees which they attack. As such they are of importance to the practical planter and must be guarded against. In the following notes, therefore, these fungi will be referred to as causing root disease of Hevea without however assuming that they are the primary causative agents.

We may distinguish between:—

(1) Erect Covers,

(2) Creeping Covers.

(1) **Erect Covers.**—These include such species as *Tephrosia candida*, *Crotalaria* sp:, *Clitoria cajanifolia*, etc. Most of these erect covers become woody after one or two years' growth, and are then liable to be attacked by the fungi which cause root disease of Hevea.

It is clear that a crop interplanted with Rubber and susceptible to attack by any of the root fungi to which the Rubber is liable, will aid in the spread of the fungus if this spreads by contact. A good example of this has recently been under the writer's observation. An old tea field, about 60 acres in extent, had been cleared and planted with Rubber about 3 years ago. The whole area was planted up with *Crotalaria* sp. and portions with *Dolichos hosei* (Vigna). The tea stumps have not been removed, and in February, 1928, a considerable amount of the fungus *Fomes lignosus* was found on the Rubber and Crotalaria. The fungus occurred in patches throughout the whole area and had apparently been responsible for the death of many Rubber saplings and Crotalaria plants. Many cases were noted of *Fomes mycelium* passing from roots of Crotalaria to those of the Rubber and *vice versa*. There can be little doubt that the presence of the Crotalaria among the Rubber had aided the spread of the Fomes.

Tephrosia candida, when old and woody, may be attacked by *Poria hypobrunnea*, while the writer has also found *Fomes lignosus* on this cover. *Fomes lamaoensis*, the fungus causing Brown Root disease, has been found on Crotalaria sp. in association with *Fomes lignosus*, *Diplodia*, and *Rhizoctonia batatícola*. It is probable that associations of these fungi with other species of cover crops will be noticed as the use of cover crops is extended.

The obvious corollary to the fact that most erect covers become liable to attack by root disease fungi when they become woody is that a time limit must be set to their growth. It is usually considered that *Tephrosia candida* should be taken up after two years while a corresponding limit may be set to the age of other covers of a similar nature. It is not sufficient merely to cut the plants down: the stumps must be extracted and burnt. If left in the ground they may be attacked by Fomes, Poria or Ustulina and become centres of further infection.

(2) **Creeping Covers.**—Most of the observations made in connection with the relation of creeping cover crops to root disease refer to *Dolichos hosei* (*Vigna oligosperma*), though the conclusions arrived at are probably equally applicable to such species as *Centrosema pubescens*, *Calapogonium mucunoides*, etc.

Whereas in the case of erect covers the spread of root disease may be favoured by the cover plants themselves being liable to the disease, in the case of creeping covers the effect is more indirect though possibly more marked. As far as is known none of the creeping covers grown under Rubber are parasitised by any of the fungi causing root disease of Hevea.

Probably the most important means by which the growth of Vigna influences the spread of root disease is in causing moist conditions in the surface layers of the soil, as such conditions favour the growth and spread of the mycelia of the fungi which cause disease. A striking instance of this was recently observed by the writer. Two or three trees growing in a rocky ravine were seen to show symptoms of root disease in the aerial portions. The ground was carrying a luxurious growth of Vigna which covered up many rocks and boulders, and on rolling this back the presence of *Fomes lignosus* was disclosed. The fungus was apparently in a very active condition mainly due to the moist conditions under the Vigna. The mycelium was growing freely over stones and boulders which, had they been exposed to the sun and air, would have offered no medium for the spread of the fungus. The apparent source of infection was a rotten jungle log, and the fungus had spread outwards in all directions to the extent of about $\frac{1}{2}$ acre. Only two or three trees in the middle of the area showed in their foliage definite symptoms of root disease; this indicates the rapidity with which the fungus had spread.

Another phenomenon which was noted on the above mentioned area, and which has been observed on other estates is the growth of mycelial strands of Fomes along the older runners of the Vigna. The Fomes does not appear in any way to harm the Vigna, but merely spreads along it. A case has been seen of a tree being infected with *Fomes lignosus* at the collar, the mycelium having reached the tree along the Vigna. The lateral roots, where they joined the collar, were quite free from the fungus, so that the mycelium had spread more quickly along the Vigna than underground.

On one estate young immature fructification of *Fomes lignosus* were found growing on a tangled mass of dead Vigna runners, and it would appear, therefore, that although Fomes is not parasitic on Vigna it can live as a saprophyte on the dead tissues. Consequently where there is a well established cover of Vigna there is a suitable medium for the growth of Fomes.

An indirect means by which Vigna may aid in the spread of root disease is by concealing it, so that its detection is rendered more difficult. A tree was recently seen on the trunk of which fructifications of *Fomes lignosus* were growing up to a height of nearly a foot. These had been completely concealed by a thick cover of Vigna as also had the mycelium on the lateral roots near the collar. The tree was nearly dead and should have been noticed earlier, but it is probable that had the Vigna not been present the disease would have been detected at the first appearance of a fructification. This difficulty is easily overcome by keeping a circular area of about 8 ft. in diameter round every tree clear of Vigna. The detection of root disease, and more especially of Ustulina collar rot, is thereby made easier. Once the circle has been cleared it can easily be kept clean by the scrappers or tappers.

In conclusion it should be understood that the assistance in the spread of root disease fungi by cover crops is not in itself an argument against growing them, and it would be a mistake for an estate to deny itself the undoubted benefits to be derived from these crops because of the possible danger from root disease. It is, however, recommended that cover crops, and in particular Vigna, should not be grown in areas known to be affected with root disease, and if already established they should be cleared away.

Summary of a Report on "Causes of Variation in Plasticity."

A full report on the "Causes of Variation in Plasticity" of rubber is in the press and will shortly be issued as Research Scheme Bulletin No. 49.

"In view of the demand for rubber of uniform plasticity, the question of the extent and causes of the variation in the plasticity of plantation rubber is receiving considerable attention both in Java and Ceylon. In tests carried out at the Imperial Institute marked differences were found in the plasticity of samples from a number of Ceylon estates and a detailed study of the causes of this variation has been commenced.

"Specimens of rubber for use in these investigations were specially prepared in Ceylon by Mr. O'Brien and were tested at the Imperial Institute by the London Staff of the Scheme six months after preparation by the methods described in Bulletin 47.

"The samples consisted of crepe prepared by (1) keeping the coagulum in the serum for different periods before rolling; (2) passing the coagulum through the rollers for different numbers of times; (3) adding different amounts of sodium bisulphite to the latex; (4) coagulating latex of different dilutions; and (5) passing dry crepe through different types of rolls to convert it into blanket crepe.

"The results of the experiments indicate that some of the methods of preparation employed have a marked effect on the plasticity of the rubber as shown below:—

Treatment.	Effect on plasticity.
Keeping coagulum in serum (maturation).	Marked decrease.
Passing coagulum through rollers for different numbers of times.	Marked increase when coagulum is rolled excessively.
Addition of sodium bisulphite to latex.	Marked decrease.
Coagulating latex of different dilutions.	Little effect.
Passing dry crepe through different types of blanketing rolls.	No definite conclusion.

"The period during which the coagulum is kept in the serum before rolling and the amount of bisulphite added to the latex appear to be two causes which may effect the plasticity of commercial grades of rubber. These conclusions are provisional and require confirmation, but it is evident that it will be necessary to pay considerable attention to both these points in future investigations.

"It has also been shown incidentally in the course of these experiments that drying crepe in hot air causes a considerable increase in plasticity. This is of importance in connection with the preparation of blanket crepe and also suggests a reason why smoked sheet is usually more plastic than air-dried sheet. These questions are still under investigation.

"Conclusions.—The results of experiments described in the report indicate that six months after preparation

(1) Crepe rubber prepared by machining the coagulum 3 hours after coagulation is about 80 per cent. more plastic than when prepared by machining the coagulum 40 hours later.

(2) Crepe rubber is nearly twice as plastic when prepared from coagulum machined more than 20 times instead of the usual number of times.

(3) Crepe rubber is about 50 per cent. more plastic when prepared from latex containing no bisulphite instead of the amount officially recommended.

(4) Crepe rubber is only slightly more plastic when prepared from very dilute latex instead of from concentrated latex or latex of normal dilution.

(5) Machine-dried crepe may be as much as 50 per cent. more plastic than air-dried crepe, and the type of rolls (whether water-cooled or air-cooled) may have an important effect on the plasticity of blanket crepe.

"Dr. de Vries has shown that the plasticities of some rubbers change considerably on keeping at tropical temperatures. The above samples were kept for about four months in the London laboratories of the Scheme in addition to a short period in Ceylon and the time occupied in transit. The conditions to which the samples were subjected are therefore similar to those occurring in practice. The effects of storage at temperatures below tropical are now under investigation.

"In connection with these experiments it is of importance to point out that none of the methods employed in the determination of plasticity give results which bear a known relation to a strictly defined physical property. The methods were devised by manufacturers, and the results are stated by them to correlate closely with factory experience.

"Concurrently with the above experiments a considerable amount of work has been carried out at the Imperial Institute with a view to a closer understanding of the principles involved in determinations of plasticity, and the results so far obtained indicate that too much importance should not be attached to the percentage differences between the samples, as the relationship appears to vary with small differences in the conditions and methods of testing. It is unlikely however that the conclusions drawn in this report concerning the direction of the effect of different methods of preparation on the plasticity of crepe will be influenced by any subsequent changes in methods of testing which may be found necessary."

Selected Articles.

Bye-Products of the Pineapple Canning Industry.

V. R. GREENSTREET, A.I.C.,

Asst. Agricultural Chemist.

and

GUNN LAY TEIK, B.A.,

Asst. Analyst.

PINEAPPLE canning has grown during recent years to be an important industry in Malaya. There is an increasing demand throughout the world for canned fruits and as the soil and climatic conditions render possible continuous cropping of pineapples Malaya appears to be in a favourable position to compete successfully with the other fruit canning countries of the world.

The cultivation of pineapples for canning purposes is peculiarly suitable for Malaya small-holders and the produce of native holdings forms a useful adjunct to factory owned plantations, although too much reliance upon native produce is undesirable as supplies are liable to be intermittent. It is important to emphasize the necessity of factories to possess their own plantations as the regularity of supplies bears an important relationship to the employment of canning machinery and the proportion of overhead costs.

The present methods employed in pineapple canning factories are inefficient in two respects. Firstly in respect of the employment of manual labour instead of mechanical contrivances and secondly in respect of the waste matter being a source of expense instead a source of income. The non-substitution of machinery for manual labour is excusable on the grounds of irregularities in the supplies of raw material but the neglect of bye-products is indefensible.

In Hawaii a vast amount of attention has been paid to the subject of bye-products and according to present methods every scrap of fruit is a source of income. The subject has received consideration from first principles namely the reduction of the fruit parings to an absolute minimum. With this object pineapple varieties are classified according to the depth of their eyes: fruit with deep eyes and irregular shaped pieces are reduced to a pulpy consistency, canned as "sherbet" and supplied to confectioners. The cores and skin after removal of everything suitable for human consumption are ground and pressed, the juice is fermented to produce vinegar and the solid residue either returned to the pineapple plantation where it has been found to be an ideal manure or else dried and marketed as a cattle fodder.

Returning to a consideration of the methods generally employed in Malaya it has been estimated that they involve at present the disposal of about two parts of waste material in the form of cores, skins and rotten and unripe fruits to each part of canned fruit. The waste is thrown upon the floor by the cutters and picked up and removed in baskets by coolies.

The baskets are carried by hand to a dump which may be situated as far as fifty or one hundred yards from the factory. The waste material contains about ninety per cent. of moisture together with fibre, pentoses, sugars, organic acids and protein matter. The fibrous fraction is tough and hard and rots with difficulty but the softer fraction is extremely liable to ferment and putrefy thus forming a prolific breeding ground for flies, beetles and other pests. It is obvious that in the course of years thousands of tons of putrefied waste must accumulate, the reduction in bulk brought about by the process of putrefaction being insignificant as may be inferred from the following table of analyses of samples drawn from a typical dump at various depths.

Table 1.

Composition of Pineapple Waste.

	Fresh Waste	Three feet below surface of dump	Four feet below surface of dump	Fresh Waste rotted 4 weeks with 3% Vitic ADCO*
	per cent.	per cent.	per cent.	per cent.
Moisture ...	95·4	89·8	99·8	83·4
Mineral Ash ...	0·34	0·59	0·63	3·53
Organic Matter (by difference) ...	4·3	9·6	9·6	13·1
	100·0	100·0	100·0	100·0
†Containing Pentos	2·8	2·5	3·9	3·96
,, nitrogen	0·08	0·2	0·14	0·55

Experiments in the decomposition of pineapple waste using various chemicals have led to the conclusion that the factor inhibiting decomposition in the dump is the excessive moisture content which even after the course of years shows no signs of diminution. If the moisture content is reduced by twenty or thirty per cent. decomposition proceeds rapidly.

Methods suggested for the disposal of the waste are as follows:—

(a) Incineration to produce an ash rich in potash and phosphates and possessing valuable manurial properties.

(b) Producing cattle food.

(c) Spreading the crushed waste on the land in shallow layers when, under aerobic conditions, the occurrence of bacterial decomposition would produce an innocuous soil-like residue amounting to about 25 per cent. of its original weight.

The successful employment of any of these methods requires the material to be partially dried by grinding and pressing. A saccharine liquor is thus produced in addition to the solid matter. The problem of the disposal of the waste therefore resolves itself into devising methods for the utilization of these two products.

It is conceivable that the combustion of the solid waste according to method (a) would supply sufficient heat for its own drying and for distillation purpose, hence this method of dealing with the waste would probably be remunerative. It suffers however from the obvious disadvantage that the organic matter of the pineapple waste is lost to the soil.

* A proprietary mixture for accelerating the rotting of vegetable waste.

† The ash of a typical sample of pineapple waste was found to contain 5·94 per cent. phosphoric acid and 23·75 per cent. potash.

Method (b) depends for its success upon the production of a well dried and ground material of more or less uniform composition. It has been demonstrated* in Hawaii that the waste is valuable as a cattle food and since cattle food to the value of $2,000,000† is annually imported into the F. M. S. a product such as that manufactured in Hawaii should find a ready market in Malaya. The cattle food marketed under the name of "pineapple bran" which is a sweet smelling granular material is nutritious, rich in vitamins and particularly suitable for working animals as may be seen by reference to the following analysis of a typical sample :—

Table II.

Composition of Hawaiian "Pineapple Bran"‡

	Per cent.
Water	10·63
Protein	3·62
Ether Extract	1·01
Invert Sugar	11·96
Starch	42·15
Fibre	18·23
Ash	3·70

For the waste to be treated by method (c) it is desirable for it to be efficiently crushed and pressed in order to eliminate most of the sugars which tend to retard decomposition. The method requires for its success the provision of a large area of land where the waste may be decomposed. Even if sufficient land adjacent to the factory were available a great deal of labour would be required while the decomposed material would again have to be loaded on to carts or lorries for return to the pineapple plantations. For the method to be successful, therefore, it is essential for the fresh waste to be transported to the pineapple plantation cheaply. It is suggested that this could be effected by returning it in the vehicle which transports the raw fruits to the factory. Since it is more compact than the raw fruit the waste from three or four loads of pineapples could be transported in one return journey. By crushing and pressing the waste from six or even seven loads of fruit could be transported in one return journey. The waste might be loaded in the following manner which would be both inexpensive and expeditious. An endless belt could be used to catch the waste falling from the cutting benches and convey it to the crushing and pressing machines upon issuing from which a second belt could convey it to a hopper situated above the roadway where the lorries discharge. The hopper could be designed to hold several lorry loads and to discharge one load at a time by the movement of a lever.

Reverting to a consideration of the expressed liquid or "juice" the composition of which may be seen by reference to Table III, its fermentation to a potable alcoholic liquid such as samsu naturally suggests itself.

Table III.

Composition of Juice from fresh Pineapple Waste.

Constituent	per cent.
Acidity (as sulphiric acid)	0·23
Acidity (as acetic acid)	0·28
Total Solids (dried at 100°C)	8·24
Sugars :—Total (calculated as invert sugar)	6·12
Invert Sugar	3·14
Cane Sugar	2·56

* According to Dr. F. G. Krauss, Professor of Agronomy, University of Hawaii "pineapple bran" realises G22/- per ton.

† Commissioner of Trade and Customs, F.M.S. Annual Report, 1926.

‡ From a paper presented before the Hawaiian Academy of Sciences, by Dr. L. A. Henke, Professor of Agriculture, University of Hawaii.

Pineapple juice contains wild yeasts and other bacteria which rapidly produce excessive acidity or sourness. For efficient alcoholic fermentation it was found essential to employ only fresh sterile juice and ferment with rice-cake* or toddy yeast. The following are the details of a typical experimental trial carried out to ascertain the optimum conditions for the production of a potable alcoholic liquor. Approximately half a gallon of fresh juice was filtered and sterilized by boiling. After cooling one per cent. of rice-cake was added. Fermentation commenced after 48 hours and was allowed to produce for a further period of 48 hours when it was practically complete. The amount of unfermented sugar remaining was found to be 0·08 per cent. and the alcohol content of the fermented juice 2·64 per cent. As the yield of alcohol theoretically possible is 3·13 per cent. the efficiency of the process is approximately 84 per cent.

Since the commercial fermentation of pineapple juice at its original concentration would necessitate dealing with a relatively large and unwieldy volume of liquid, experiments were carried out to determine to what extent the original juice could be concentrated without affecting the rate of fermentation. It was found that satisfactory fermentation could be obtained by concentrating pineapple juice to approximately 40 per cent. of its original volume that is to say raising its sugar content to about 15 per cent. As a result of the success of laboratory experiments it was decided to carry out experiments on a large scale at a canning factory. About 8 gallons of fresh juice from the filter press were concentrated in a large steam-jacketed pan to about 40 per cent. of its original volume, cooled to about 40°C, transferred to a carboy and toddy yeast added. Fermentation commenced within a few hours and was allowed to continue for 2 days: one gallon of the liquid was distilled and the alcohol content of the distillate found to be approximately 35 per cent.

Table IV shows the alcoholic strength of distilled fermented pineapple juice compared with that of typical samples of brandy and samsu.

Table IV.

The Alcohol Content of Distilled Fermented Pineapple Juice, Brandy and Samsu.

Liquor.		Alcohol content per cent. by weight.	Proof spirit per cent.
Pineapple	...	34·9	73·0
Brandy	...	38·5	80·0
Samsu	...	27·5	58·0

Summary:—Compared with those employed in Hawaii—Malayan methods of pineapple canning are efficient particularly with regard to the non-economic disposal of waste matter.

For economic disposal of the waste matter removal of the juice by expression is shown to be essential. Remunerative methods of disposal of the partially dried waste are described.

It is shown that the fermentation and distillation of the fresh juice for the production of a potable alcoholic liquor similar to brandy or samsu is a simple process.—*The Malayan Agricultural Journal*, Vol. XVI., No. I., 1928.

* A chinese product containing mucor and yeast and used in the manufacture of samsu for saccharification and subsequent fermentation of rice. It consists of a mixture of cooked rice, soya beans and clay.

Small Holdings Competition.

UNDER the terms of the Small Holdings and Allotments Acts, 1908-26, small holdings varying in area from one to 50 acres have been provided by every County Council in England and Wales, and by a number of County Boroughs, in order to meet the needs of suitable applicants. The total area of land sold or let by Councils in small holdings under the Acts is over 440,000 acres, the holdings numbering more than 29,000.

In order to encourage better cultivation and management by the occupiers, several Councils have organized competitions for the best-managed small holdings in their area. Usually such competitions are arranged in conjunction with established agricultural shows in the county, and they may be either limited to holdings provided by the Council or open to all small-holders in the county whose holdings fall within the prescribed categories.

The reports of the judges on the holdings entered for competitions of this kind frequently yield illuminating comments on the position and prospects of the competitors, and go far to dispel the pessimistic views sometimes expressed as to the prospects of small-holders in present agricultural conditions. It is by no means uncommon to find that the judges' reports comment both on the high level of cultivation of the holdings, and on the success and contentment of the competing small-holders. The fact which many critics of small holdings fail to realize is that, in some directions, notably in their comparative independence of hired labour and in the personal care and attention they are able to give to all details of the work, small-holders, by dint of incessant hard work, are in a stronger position than many larger farmers. In many cases, the advantages are more than sufficient to counterbalance the obvious disadvantages of working on a smaller scale. That ignorance of the facts is frequently responsible for criticisms, directed against the small holdings movement, is demonstrated by the instances reported in which practical farmers who had no belief in small holdings have been appointed as judges in these competitions, and have subsequently announced that the experience gained in carrying out the necessary inspections of the competing holdings has resulted in their complete conversion.

One of the most recently instituted competitions of this character was held by the Hampshire County Council in 1927. There were 68 entries in all, and the reports of the judges were very favourable. Certain holdings evoked special mention because of the excellence of the crops and cultivation and the neat appearance of the holdings. On the recommendation of the judges the Committee decided to award additional prizes in two of the six

classes into which the entries were divided. The judges also called attention to the beneficial effect which the Ministry's Live Stock Scheme is having on the quality of the stock kept on the holdings.

A similar competition held in Norfolk in 1927 produced an interesting report, in which the judges spoke highly of the cultivation, cropping and condition of the arable land, but expressed the view that the pasture land required more attention. They were agreeably surprised at the number of cows kept by the competitors, and drew attention to several instances of pedigree bulls and boars being kept.

The following extracts are taken from reports of competitions held in recent years in Salop and in the Lindsey Division of Lincolnshire respectively :—

Salop.—It has been a great pleasure to find such a high level of management on the respective holdings.

Most of the holdings are heavily stocked, and it has been a pleasurable surprise to us to find the freedom with which purchased concentrated feeding stuffs are being used.

It is also very gratifying to note that, while many ex-service men are making their mark, some of the leading competitors are men who have worked their way up from the position of farm workers and are now obviously ready to take over even larger holdings, thus proving that the small holdings movement is fulfilling a very real function in providing a ladder for the farm worker to better his position in life.

Lindsey.—On visiting the small holdings, nearly 50 in number, it was very pleasing to find that, with the exception of one or two, they are farmed in such a manner that the tenants cannot help but be successful.

Every smallholder seemed contented and happy, and imbued with the desire to improve his position. Given fair seasons and reasonable rents and a continuance of the good farming which was so noticeable, we feel sure that the development of small holdings must be an asset to the county.

We also could not help but notice what a great help to these people our County Agricultural Organizer is with his advice and experiments. It was pleasant to see the readiness with which they sought his guidance and advice.

The reports of these competitions also frequently bring to notice striking examples of individual success due to specialization in some particular branch of the farming industry. Thus, mention was made in the report on the Lindsey competition, referred to above, that one of the competitors had won the Breed Championship Prize for curly-coated pigs at Smithfield Show for six years in succession.

Again, in a recent competition in Middlesex, the winner of the first prize in one of the classes was an ex-photographer who now specializes in pigs and poultry, and the judges, in their report on the competition, commented on his original and effective methods of feeding and housing his stock.

Another conspicuous instance of a succesful smallholder is reported from Surrey, where the tenant of one of the Council's dairy holdings, though he had had no agricultural expericence before the war, has succeeded three times in winning the Clean Milk Competition for his county and has built up a very profitable business.

A final instance may be quoted of the success of a statutory smallholder in open competitions of a less specialized character. An ex-service tenant of the Wiltshire County Council was successful in winning the First Prize and Ten Guineas Cup presented by the Beaufort Hunt in the open class in a county competition for the best-managed small holdings, and subsequently the same tenant was awarded a First Prize in a class of smallholders and, also, a Twenty-five Guineas Cup presented by the Avon Dale Hunt, open to all farmers, irrespective of area, farming within the limits of the hunt.

The smallholders' wives, by careful attention to the interior of the dwelling house, as well as the garden play their part in ensuring the success of the prize winners, and numerous pleasing testimonies to the excellence of these domestic items have been noted.—*The Journal of the Ministry of Agriculture,* Vol. XXXIV. No. 11, 1928.

Meetings, Conferences, Etc.

Board of Agriculture.

Estates Products Committee.

Minutes of the Thirty-ninth Meeting of the Estates Products Committee of the Board of Agriculture held at the Head Office of the Department of Agriculture, at 2-30 p.m. on Tuesday, September 11th, 1928.

Present:—The Director of Agriculture (Chairman), The Government Mycologist, The Government Entomologist, The Government Agricultural Chemist, Gate Mudaliyar A. E. Rajapakse, Commander C. Goolden, Dr. C. A. Hewavitarne, The Hon. Mr. T. B. Panabokke, Messrs. C. A. M. de Silva, S. Pararajasingham, C. E. A. Dias, J. Ferguson, A. Coombe, E. Maberley-Byrde, E. W. Keith, J. H. Armitage, C. C. Du Pre Moore, J. D. Dunlop, A. T. Sydney-Smith, J. Horsfall, Wace de Niese, H. D. Garrick, E. F. Home, A. W. Ruxton, A. E. H. Trimmer, R. G. Coombe, E. C. Villiers, G. Brown, F. R. Dias, I .L .Cameron, L. A. Wright, and T. H. Holland, (Secretary).

Visitors:—Messrs. J. W. Ferguson, L. B. Green, N. K. Jardine, and L. Lord.

Letters or telegrams regretting inability to attend were received from the Hon. Mr. D. S. Senanayake, Messrs. R. P. Gaddum, H. L. De Mel, G. R. de Zoysa, and G. Pandittasekera.

Agenda Item 1.—Confirmation of Minutes.

The minutes of the last meeting having been circulated to members were taken as read and confirmed.

At this stage the Chairman referred to one of the recommendations of the committee to advise on the extension of the work of the Department of Agriculture which was that separate annual reports should be published by the different divisions of the Department. These reports were now ready for distribution. The reports dealing with pests and diseases and the report of the Experiment Station, Peradeniya, would be sent to all estates while the Divisional Agricultural Officers' reports would be widely circulated within the divisions concerned. Copies of the reports were tabled.

Agenda Item 2.—Progress Report of the Experiment Station, Peradeniya, for the months of July and August, 1928.

The Chairman briefly reviewed this report.

Mr. C. E. A. Dias referred to a record of rubber budding done mentioned in the previous report of the Station and asked that figures of percentage successes obtained be published in the progress reports.

The Chairman emphasised the difficulty in comparing results in different localities. The season had a marked influence and the best season for one district would not necessarily be the best in another district. He gave some figures of success obtained in the Royal Botanic Gardens which varied between 17% and 93%, the highest figure being obtained in August.

Mr. Dias intimated that he had also found that August was the best month for budding.

Mr. Brown enquired if any member had had any experience with *Indigofera endecaphylla* in young tea.

Mr. Horsfall said that he had planted Indigofera in young tea and was satisfied with the results, but that Indigofera plants should not be put in close to the holes for tea plants.

Mr. Panabokke said that his experience was that Indigofera tended to retard the growth of young tea.

Mr. Sydney-Smith confirmed this view and gave it as his opinion that the planting of Indigofera in old tea which gave a good cover was not desirable. In tea where much soil was exposed it might be advantageous. He was inclined to think that the cover crop absorbed too much moisture at the expense of the tea.

The Chairman said that the Peradeniya experiments were designed to test the effect on the yields of permanent crops: the effect of loss of moisture was also being investigated.

Mr. Wace de Niese enquired whether the three avocado pear trees reported as dying were old trees or not.

Mr. Holland replied that they were old trees; he believed they were planted in 1910.

Referring again to the percentage successes obtained in rubber budding on the Experiment Station, Mr. Holland informed Mr. Dias that the figures could be provided but would not be particularly valuable because they included results obtained with budwood received in every sort of condition and buddings on very old stocks which had already recently been budded two or three times.

The Progress report was then adopted.

Agenda Item 3.—Chilaw Coconut Trials—Discussion of results.

The Chairman said that this report had already been on the agenda for two meetings. He reviewed the report.

Mr. C. A. M. de Silva said that the experiments had been in progress for a number of years and appeared to be yielding no useful results. He suggested that a change should be made and a new set of experiments designed.

The Chairman pointed out that the Department had a lease of the land for 25 years. In 1921 a sub-committee had been appointed to consider the question of the abandonment of the experiments or to recommend changes. The recommendations of that sub-Committee had been put into effect. He deprecated a further change and emphasised the necessity of continuing experiments over a number of years.

Gate Mudaliyar Rajapakse said that he had been a member of the sub-committee referred to. He had been in favour of abandoning the experiments, but as it had not been possible to cancel the agreement with the proprietor the sub-committee had recommended the continuance of the experiments on certain lines. He did not however think that the experiments were of very great benefit to the coconut industry.

Mr. Wace de Niese suggested that the question should be postponed for consideration by a more representative meeting. He deprecated a hasty decision.

The Chairman suggested that the present experiments should be continued for a year by which time the Coconut Research Scheme might be in a position to inaugurate a scientifically planned experiment.

The meeting finally agreed to this course.

Agenda Item 4.—Brown Bast.

Mr. C. E. A. Dias asked the following questions on brown bast:—

(a) The cause of brown bast.

(b) When does it start.

(c) In what direction does it travel.

(d) How long will it take to infect the whole of the tapping panel.

The Chairman replied that he was afraid he was not in a position to answer without qualifications any one of Mr. Dias' questions. Scientific opinion differed greatly on the subject and methods of treatment varied in different countries. Any dogmatic assertion on the subject would be bound to be challenged, could lead to no useful purpose, and could not be justified. The bulletin recently published by the Rubber Research Scheme indicated a method of treatment found successful in Ceylon: in Java other methods were in use, and in Malaya other methods again. If Mr. Dias wished to suggest any particular line of work that he considered should be taken up he was ready to consider such a proposal.

Mr. Dias said that his experience of brown bast was that it started on the tapping cut. On his return from Java he had adopted the isolation method on his estates and since 1926 not one tree had gone out of tapping on account of brown bast. He thought that it should be given a trial.

The Chairman undertook to try and arrange for a comparison of the scraping and isolation method with the method of isolation without scraping.

Agenda Item 5.—Dying back of Vigna on Rubber Estates.

Mr. C. E. A. Dias said that a great deal of old vigna was dying back and it was found that where this had occurred other cover crops could not be successfully grown on the land.

Mr. A. Coombe said that a great deal of damage was done to Vigna by snails. On old estates he believed the cause was often due to lack of manuring.

Mr. J. D. Dunlop said that he had been informed by a Straits planter that land sometimes got "Vigna sick" and further growth of vigna could not be expected on such land. A mixture of two cover crops was sometimes planted so that when the Vigna died out the other cover crop came on.

Dr. Small said that *Rhizoctonia solani* had been found on all the specimens sent in to him. He thought however that an insect attack was often concerned.

Dr. Hutson said no serious cases of insect attack on Vigna had been brought to his notice.

Mr. A. Coombe said that when Vigna started to die out he planted the middle sized Desmodium and found that the Vigna thereafter usually came on again.

The Chairman asked that any serious cases of damage to or dying of Vigna should be reported to the Department in order that an officer might examine the trouble on the spot.

He mentioned that Mr. Roy Bertrand had sent an article for publication in the *Tropical Agriculturist* describing a successful method of trapping snails by covering stones with limewash containing a little Atlas preservative. Snails were attracted to the lime and died as a result of consuming the Atlas preservative. He had heard of a staling effect on land in Java and Sumatra where Vigna had been in situ for some years. Three years had been reported. He believed in the proper agricultural treatment of Vigna and other cover crops. They should be forked occasionally. It was wrong to think that any cover crops should be allowed to continue without cultural treatment.

Mr. R. G. Coombe asked if experiments in the cultivation of different cover crops could be arranged.

The Chairman said that he would endeavour to arrange for some such trial to be carried out by the Rubber Research Scheme.

Agenda Item 6.—Budded Rubber.

Mr. C. E. A. Dias referred to the proposals for the selection and testing of high yielding strains of rubber put before the committee in January, 1928. These proposals did not indicate the number of clones to be tested. It was further stated that an adequate supply of budwood was assured for the 1928 area of 10 acres on the Iriyagama Division of the Experiment Station, Peradeniya. He wished to have full particulars of these mother trees under the following headings:—

1. Number
2. Name of Estate,
3. Situation,
4. District,
5. Elevation,
6. Rainfall,
7. Period of records kept.
8. Whether the records are kept under the supervision of an officer of the Department of Agriculture.
9. The yield of latex and dry rubber per year.
10. The number of days tapped and on which records were taken.
11. The yields of latex and dry rubber for each tapping in grammes.
12. The yield of latex for each foot of tapping bark per year.
13. The yield of latex for each foot of tapping bark per tapping.
14. The number of rows of latex vessels.

He said he had had occasion to ask for this information from the Secretary in regard to the budded plants at Nivitigalakele and the information had been denied him. The Secretary had further informed him that subscribers to the Scheme had the right to get their mother trees tested at the Experiment Station and keep the records themselves. The Chairman had stated to him that all producers of rubber were free to become members of the Scheme and to obtain all the information available, but within eight months of that assurance information had been denied to a member of the executive committee. Mr. Dias said that he knew of trees which had given from 700 to 800 ccs. of latex in a single tapping, but the yield had soon dropped to half that amount; such trees were useless for propagation. Nivitigalakele Experiment Station was Crown land and Government contributed Rs. 67,000·00 annually towards the

Scheme. It was therefore not proper that a station subsidised by Government should undertake to test mother trees for individual estates or persons in order that they might get the Government Hall Mark for their trees and make a monopoly of the sale of budwood at the expense of the rubber growing public.

The Chairman said that the portion of Mr. Dias' remarks regarding the Rubber Research Scheme did not really concern The Estates Products' Committee. He referred first of all to Mr. Dias' enquiries as regards the Iriyagama Division of the Experiment Station, Peradeniya. The proposals were placed before the committee in March, 1928. These proposals stated that eighty acres were available and that one clone per acre would be tested. The total number of clones to be tested was therefore eighty. Full details had been given as to the work for the first year and a rough plan of the proposals for subsequent years. Budwood from fourteen trees from which the ten mother trees required for the first ten acres was in sight and orders had been given to pollard a number of high yielding trees at Heneratgoda for use in the next areas to be cleared. He saw no necessity to publish voluminous details of these mother trees since it was only after the trees had been tested that such information had any value. He quoted from a letter from the Director of the A.V.R. O.S. Station in Sumatra recording the opinion that the value of such information as Mr. Dias asked for was extremely problematical. He said that Mr. Dias might rest assured that precautions would be taken that only the best available material would be tested. With regard to the Nivitigalakele Experiment Station, Mr. Dias had been told that he might see every record. Mr. Dias had asked for certain details which he, as Chairman, thought should not be generally circulated. There was no question of concealing information from Mr. Dias.

Mr. Dias said his reason for asking for the information was that there was a certain tree which the Department thought was a very high yielder; the yield of that tree had suddenly declined. The matter should be investigated. There was no use in waiting seven or eight years and then finding that a mistake had been made and that the mother tree was a poor yielder An officer of the Department should go to every estate and see that proper records were being kept. There was no difficulty in publishing data.

The Chairman said if Mr. Dias had clearly stated that his reason for requesting this information was because he doubted the yield records of a particular tree, a difference of opinion might have been avoided. He wished to emphasise the fact that it was only by tapping the budded offspring of a tree that its value as a mother tree could be decided. A high yielder might be perfectly useless as a mother tree whilst a more moderate yielder might prove a good mother tree. It had been found to be the case in Cacao in the West Indies and in Rubber in the Dutch East Indies. The initial choice of budding material must be left to the judgment of the scientific officers concerned.

After some further discussion Mr. Dias asked whether eventually seed and budwood from proved clones would be available to the Rubber Industry of Ceylon.

The Chairman replied that as regards material from the Rubber Reasearch Scheme the matter would have to be decided by the Executive Committee of that Scheme. He would personally be in favour of such a course as that was, in fact, the whole object of work of this nature.

Mr. Dias then referred to an Advertisement which had appeared in the *Times of Ceylon* and which read as follows:—

"Budwood, Heneratgoda No. 2 stock, budded from Heneratgoda proved high yielding progeny. Price 50 cents per foot. —Superintendent, Digalla, Dehiowita."
Dehiowita."

He asked the following questions:—

1. "Has the Department of Agriculture any *proved* mother trees from the progeny of No. 2 Tree, Heneratgoda.?
2. Did the Department supply any budwood to the Superintendent of Digalla, Dehiowita, at any time and say that it was from proved mother trees?
3. Has anybody proved any clones from the progeny of No. 2 tree? If so what are the yield records? if not will the Department of Agriculture take such steps as are necessary to contradict this statement, as such statements are bound to do much harm to the budded rubber industry."

The Chairman said that in 1922 a budding demonstration had been held at Peradeniya. At the end of the season a number of plants were left over and some of these were sold to Digalla Estate. These plants were No. 2 Heneratgoda stocks budded with budwood from the then high yielders of the progeny of No. 2 Heneratgoda growing at Peradeniya. The wording of the advertisement was, therefore, strictly accurate and he was unable to interfere. In any case it was a matter between the purchaser and the supplier and he failed to see how the Department could take upon itself to become the arbiter on what was a sound advertisement and what was not. Confusion had arisen in this case over the word "proved progeny."

Agenda Item 7.—Shot-hole borer Regulations—Proposed Amendments.

Copies of the new proposed regulations had been circulated to members. The Chairman commented on these.

Mr. Sydney-Smith questioned how it was possible to tell whether a nursery had been planted from good seed or not. The regulations were admirable but he enquired whether it was practicable to carry them out. The Committee had been informed at the previous Meeting of the enormous number of nurseries in the Kandy district, could the grading and inspection of these nurseries be carried out?

Mr. Jardine said that the question of the origin of the seed did not present such great difficulties because most of the nurseries were owned by small cultivators who took the seed from their own bushes. The inspection of all nurseries was already being carried out, though with the existing staff the work was arduous.

The Chairman suggested that para 4A of the proposed amended regulations should be altered to read as follows:—

"Nurseries in acres free from Shot-hole Borer and containing good plants and under good cultivation."

This alteration was agreed to and the amended regulations were then passed for recommendation to Government.

Agenda Item 8.—Tea Tortrix Returns for Second Quarter.

The Chairman commented on these returns which had been circulated to members. He hoped that the diminishing returns were the result of general co-operation in the collection of egg masses.

Mr. Sydney-Smith commented on the exceptionally large return sent in by Moray Group which amounted to half the total for the whole Maskeliya district.

Mr. Jardine said he was bound to accept the returns sent in by Superintendents.

The Chairman said that much attention was not paid to large returns but unduly small returns were usually made a subject of investigation. In order to see if the pest had disappeared or been brought under control.

Mr. J. Horsfall drew attention to the figures for the Baddula and Haputale districts and suggested the possibility of the figures from these two districts having been transposed.

The Chairman promised to look into the matter.

Agenda Item 9.—Leaf Diseases of Rubber.

Mr. H. L. De Mel had sent in the following question:—"Has the leaf disease in rubber known as Aschochyta Rim Blight been reported to the Scientific Department from several districts? Has the incidence been traced to the occurrence of an excess of nitrogen in the soil?"

Mr. De Mel was not present.

Dr. Small said that the answer to the first part of the question was, Yes, and to the second part, No.

T. H. HOLLAND,
Secretary,
Estates Products Committee.

Departmental Notes.

Progress Report of the Experiment Station, Peradeniya.

For the Months of July and August, 1928.

Tea.

Further observation of young tea plants planted as supplies in a thick cover of *Indigofera endecaphylla* shows that, though the growth is usually healthy, such plants tend rather to run up after centering instead of forming the desired spread.

Rubber.

Dolichos hosei has been planted along the terraces in the Hillside rubber.

The ripening of seed was somewhat delayed by prolonged wet weather but collection was in full swing by the end of August.

The yield of plots 14—15 (offspring of No. 2 Tree Heneratgoda) from June 1st, 1927, to May 31st, 1928, amounted to the equivalent of 618 lb. per acre. although 10 out of the 161 trees had been pollarded or treated for brown bast and were out of tapping.

Cacao.

The new hot-air artificial drying plant was used for the first time in July and proved on the whole satisfactory.

Coffee.

All vacancies in the six-acre coffee field were supplied.

Green Manures and Cover Crops.

Two leguminous trees imported from Assam in May, 1926, under the local names of " Mukuk " and " Mowon," and planted later in the Half Acre Tea plot, have been identified as *Albizzia procera* and *Albizzia chinensis* respectively. The former appears to stand lopping well but not the latter.

Indigofera endecaphylla planted 6' x 6' in plot 166 (Tea) has formed a complete ground cover in 1 year.

The three most successful ground cover crops of the indigenous creepers so far tried are *Phaseolus radiatus, Dolichos falcatus*, and *Rothea indica*. The latter is a small close growing plant to which the disadvantages found in the case of the smaller Desmodium may possibly apply.

It is found that *Centrosema pubescens* planted among quite young rubber is rather too vigorous and somewhat difficult to control.

Soil Erosion Experiments.

In Area "B" the second year was completed on July 31st, 1928. A comparison between envelope forking twice a year and no forking is in progress there. The figures are given below.

1926-27

All plots similarly treated.

Losses of dry soil.

	lb.	oz.		lb.	oz.
B 1	741	5	B 3	455	8
B 4	553	8	B 6	1252	13
Total	1294	13		1708	5

Excess of erosion in B 3 and B 6 over B 1 and B 4, 413 lb. 8 oz. = 32%

1927-28

B 1 and B 4 twice envelope forked.
B 3 and B 6 Controls.

Losses of dry soil.

	lb.	oz.		lb.	oz.
B 1	2730	10	B 3	658	0
B 4	1056	13	B 6	2373	0
Total	3787	7		3031	0

Excess of erosion in B 1 and B 4 (forked) over B 3 and B 6 (controls), 756 lb. 7 oz. = 25%

Total increase in erosion due to forking, 57%. These results are striking. They are to be tested by another year's records after which it is proposed to carry out a test between weeding with scrapers and with other special tools. It has also been suggested that envelope forking should be tested against forking with inversion of the soil.

Fodder Grasses.

The yield trials initiated in 1921 were brought to a conclusion on July 31st, 1928, mainly on account of the increased growth of young coconuts which are interplanted in these plots. The results have been summarised in bulletin form.

Since the conclusion of the trials all grasses have been uprooted to a distance of nine feet round the young coconut palms.

Fruit.

Three adjacent Avocado Pear trees died in July. The death was attributed in all three cases to *Rhizoctonia bataticola*.

Another year's records from the quarter acre of Kew Pines in plot 20 A are now available and are given in the following table together with the figures for the two previous years. It will be seen that although the yield has declined, the expenditure has likewise declined and profits are maintained. These high profits are partly accounted for by the absence of any marketing expenses. All fruits are sold on the Station and the demand is usually greater than the supply.

Summary of Yields on Profits from Plot 20 A Planted with Kew Pines July, 1928.

Period	Number of Fruits harvested		Weight of fruits		Average Weight of fruits	Expenditure		Revenue		Profit	
	Per plot	Per acre	Per plot	Per acre		Per plot	Per acre	Per plot	Per acre	Per plot	Per acre
			lb.	lb.	lb. oz.	Rs. c.	Rs. c.	Rs. c.	Rs. c.	Rs. c.	Rs. c
April 1924 to June 30th 1926 (first year of fruiting July 1st 1925 to June 30th 1926)	858	3432	5210	20840	0 3	175·58	702·34	353·97	1415·88	178·39	713·54
July 1st 1926 to June 30th, 1927.	513	2052	2133	8532	4 2	40·60	162·40	203·38	813·52 8	162·78	651·12
July 1st 1927 to June 30th 1928.	455	1820	2188	8752	4 12	25·87	103·48	191·30	765·20	165·43	661·72

Fibres.

A second extraction of fibre from Columbian Pita (once known under the trade name of "Arghan") was made in July 1928. The figures are given below in comparision with figures obtained from a similar test two years ago.

	1926	1928
Number of leaves used	120	200
Average weight of a leaf	4·6 oz.	5·4 oz.
Average length of leaves	5ft. 5in.	5ft. 7in.
Average breadth of leaves	—	3·8 in.
Period of retting	21 days	21 days
Weight of dry clean fibre	8 oz.	8½ oz.
Percentage dry fibre to weight of leaves	1·2%	·94%

This percentage outturn is very low compared with Sisal and does not indicate the probability of extensive economic value for this fibre crop. The fibre was also rather brittle and inclined to break during extraction.

General.

The continued wet weather in August interfered considerably with work and has caused weeding to fall into arrears

The Iriyagama Division.

Nitrate of soda was applied to the nurseries planted with stumps for budwood nurseries as well as to the stumps in the clearing.

The division of the 1927-28 area into blocks of 240 trees and plots of 24 trees is in progress.

The timber on a proposed clearing of a further extent of 47½ acres was auctioned on August 1st and clearing is in progress. The succeeding fortnight of continuous rain greatly hampered the work and it is possible that the contractors' time limit of October 15th may have to be extended. Basket plants—to be later budded in the field—are in readiness for planting up this clearing.

T. H. HOLLAND,
Manager,
Experiment Station, Peradeniya.

Agricultural Competitions in the Southern Division.

Agricultural competitions in Matara, Galle and Kalutara Districts of the Southern Division were held during 1927-28 for the cultivation of vegetables, selection of seed paddy, green manuring of paddy fields and for the cultivation of chillies and cotton in the Hambantota District, results of which are now available.

There were 45 competitors in the vegetable garden competition and entries were received from Gangaboda and Kandaboda Pattus, Weligam Korale and the Four Gravets, and awards were made as follows :—

Gangaboda Pattu.

1. D. T. Wanigasekera of Malana Rs. 25-00
2. Liyanapatirange Don Bastian of Hettiyawala Rs. 15-00
3. R. Don Deonis of Hettiyawala Rs. 10-00

Kandaboda Pattu.

1. B. A. Wickremesinghe of Kongala Rs. 25-00
2. Don Samel Jayasundra of Kebillyapola Rs. 15-00
3. L. A. Dingiri Appu of Beruwala Rs. 10-00

Weligam Korale.

1. H. P. Hardine of Denepitiya Rs. 25-00
2. S. O. Weerasinghe, Denepitiya Rs. 15-00
3. A. P. Ginnappu, Denepitiya Rs. 10-00

Four Gravets.

1. D. D. Manatunga of Weragampitiya Rs. 25-00
2. M. C. Don Andris of Malagoda Rs. 15-00
4. S. P. Don James of Wewaihalagoda Rs. 10-00

Competitors numbering 51 entered for the paddy sheaf competition (selected seed paddy) representative of Gangaboda, Wellaboda, Kandaboda Pattus and the Four Gravets of Matara, the largest number—24—being from the Wellaboda Pattu, from which centre the winner of the first prize exhibited a sheaf of paddy over 20 pounds in weight, while the 2nd and 3rd prize winners each exhibited sheafs weighing 12 and 11 pounds respectively.

Judging resulted as follows :—

Gangaboda Pattu

1. D. A. Liyanage of Kitalagama Rs. 25-00
2. G. W. Don Mallis of Gapugoda Rs. 15-00
3. D. M. Palihakkara of Kirinda Rs. 10-00

Wellaboda Pattu.

1. T. K. Carolis of Parawehera Rs. 25-00
2. A. H. Don Davith of Nactunna Rs. 7-50
3. Mahadurage Mendis of Tatalla North Rs. 5-00

Kandaboda Pattu.

1. D. D. S. Gunasekera of Wepotaria Rs. 12-50
2. W. L. G. Peneris of Kebeliyapola Rs. 7-50
3. D. D. S. Rajepakse of Wanegama Rs. 5-00

Four Gravets.

1. R. G. D. P. Weerasinghe of Nakawita Rs. 18-50
2. Gardius Samaraweera of Nakawita Rs. 7-50
3. S. A. Arnolis Appu of Nakawita Rs. 5-00

A competition for the green manuring of paddy fields was conducted when a number of competitors took part from the Four Gravets, Wellaboda, Gangaboda, Kandaboda Pattus and Morawak Korale of Matara. Fields entered for competition had to be inspected on various occasions and the final judging resulted as follows :—

Four Gravets

K. B. G. P. Weerasinghe of Malagoda Rs. 15-00

Wellaboda Pattu.

W. A. Don Andris Wijesinghe of Uda Aparakka Rs. 15-00

Gangaboda Pattu

D. A. Liyanage of Kitalagama Rs. 15-00

Kandaboda Pattu.

D. Don Bastian of Denegama Rs. 15-00

Morawak Korale.

M. S. D. Arnolis of Kalubowitayama Rs. 15-00

A chillie cultivation competition was also held in West Giruwa Pattu when 27 competitors entered. The plots entered were satisfactorily cultivated in spite of the unfavourable climatic conditions. The following prizes were awarded :—

1. Agalakkada Arachige Kirigoris, Horawinna Rs. 20-00
2. Wickremesekera Aratichige Hoonappu, Gonadeniya Rs. 10-00

A cotton cultivation competition was held in West Giruwa Pattu among 40 entrants. The cultivators were faced with considerable difficulty owing to the unevenly distributed rainfall, but the majority of the competitors had satisfactory cultivations. The following were adjudged winners :—

1. Liyanage Salamon of Gonadeniya Rs. 20-00
2. Goonanage Kira of Moomanakolodeniya Rs. 5.00
2. Hatharinge Caronisa of Moomanakolodeniya Rs. 5-00

A vegetable garden competition was held in Panadura and Kalutara Totamunas among 36 competitors. A noticeable feature in this competiton was similarity in the varieties cultivated due largely to the demand of the local market.

The competition was satisfactory, and the following were awarded prizes :—

1. I. D. Edwin of Alubomulla Rs. 30-00
2. K. James Peiris of Galtuda ,, 17-50
3. N. Peter Peries of Hirana ,, 10-00

In the same competition extended to Pasdun Korale East and West there was a total of 85 competitors. In these areas most of the competitors made little endeavour to cultivate their fields satisfactorily as they were owners of rubber lands.

The following were adjudged winners :—

Pasdun Korale West.

1. D. C. Weerasuriya Appuhamy, Mehinon Rs. 30-00
2. H. D. J. Jayasekera, Naattaduwa Rs. 17-50
3. V. D. S. Appuhamy, Horawela Rs. 10-00

Pasdun Korale East.

1. D. A. Goonesinghe, Ratmako Rs. 30-00
2. D. O. Samaranayake, Kurapita Rs. 17-50
3. B. V. Leveris, Bellana Rs. 10-00

Competitions were also held in Matara and Galle Districts for the cultivation of vegetables and for paddy. For the vegetable garden competition entries from Morawak Korale in Matara District and Gangaboda Pattu, Talpe and Hinidum Pattus and the Four Gravets of Galle were received.

Of the 4 competitors from Morawak Korale an award of Rs. 25/- was made to D. S. H. Gunawardena of Pallegama.

No awards were made for Gangaboda Pattu, and in Hinidum Pattu D. M. Wijewardena was awarded the second prize of Rs. 17-50.

There was quite a large number of entries from the four Gravets of Galle and competition was keen. The following were awarded prizes :—

1. C. Sampson Dias of Maitipe Rs. 30.00
2. Hapagalage Francis de Silva Rs. 17-50
3. Samaraweera aratchige Deonis de Silva of Ulawitake Rs. 10-00

In the paddy cultivation competition confined to Gangaboda Pattu, Talpe Pattu and the Four Gravets there were 33 competitors and awards were made to the following :—

Gangaboda Pattu.

1. S. Withanachi of Baddegama Rs. 30-00
2. E. W. Dahanayake of Telikade Rs. 17-50
3. Sam Withanachi of Ganegama Rs. 10-00

In Talpe Pattu the second prize of Rs. 17·50 was awarded to T. G. C. S. Samarawickrema of Polpagoda.

The following were awarded prizes in the Four Gravets :—

1. Koragodagamage Sinno Appu of Ihalgoda Rs. 30-00
2. P. W. James Silva of Manwila Rs. 17-50
3. D. L. S. Wanigaratne of Manwila Rs. 10-00

Colonel Wright Prize Competition in North-Western Province.

The inspection of school gardens in the Kurunegala and Puttalam-Chilaw districts for the award of the prize of Rs. 100/- offered annually by Lt. Col. T. Y. Wright was undertaken during the yala and maha seasons. In allotting points during the judging all factors such as soil, climate, proximity of the source of water supply, manuring and mulching and extent of land available for cultivation were taken into consideration.

All school gardens entered for competition were decidedly better than in previous years, and marked attention had been paid to the cultivation of vegetables and curry stuffs

In the Kurunegala District Kalugamuwa Boys' Vernacular School has been adjudged winner of the first prize, while second place has been secured by Kobolgana Vernacular Mixed School.

In the Chilaw-Puttalam District Walahapitiya Boys' Vernacular School has secured first place.

Competition for the Hon. Sir Stewart Schneider's Challenge Cup for School Gardens.

The challenge cup offered for competition among school gardens in the Chilaw-Puttalam district by the Hon. Sir Stewart Schneider has been won by CH/Walahapitiya School for the year 1927-28.

This competition has been organised for the fifth year in succession, and as a result school garden work in the district has improved year by year.

For the 1927-28 competition 10 schools entered, and attention had been paid to the satisfactory cultivation and maintenance of the ornamental, vegetable and fruit sections of the school gardens.

Honourable mention is made of the Medagama School which had shown great keenness in the garden work, and come second in order of merit.

Curry Stuffs Cultivation Competition, Matale District.

A curry stuffs cultivation competition was held in the Matale District during the yala season when there were 48 competitors as against 12 only for the competition held during the previous year.

The competitors had grown from six to ten varieties of curry stuffs, among which were onion, garlic, turmeric, ginger, fennel, coriander, chillie, fenugreek, mustard and aniseed.

All gardens were repeatedly visited by the Agricultural Instructor for giving advice. He was also responsible for the preliminary judging, and the final judging was done by the Divisional Agricultural Officer.

The following have been awarded prizes :—

1. K. H. P. Bandia Veda of Raitalawa Rs. 50-00
2. U. B. Lewley of Ukuwela Rs. 30-00
3. B. L. D. Carolis of Walliwela Rs. 20-00

Matale North Vegetable Garden Competition, 1927-1928.

A vegetable garden competition was organised for cultivators in Matale North and was well advertised by the Agricultural Instructor through the headmen.

The gardens were systematically cultivated with various kinds of vegetables and competition was keen among the 17 cultivators who sent in their names.

At the final judging conducted by the Agricultural Instructor the following were adjudged winners.

1. Punchi Banda of Tolambugalle Rs. 30-00
2. William Singho of Bambawa Rs. 20-00

Pure-line Paddy Growing Competition, 1927-28.

A pure-line paddy growing competition was held during yala 1928 in the Harispattu and Yatinuwara areas of the Kandy District when 32 growers entered for the competition, the type sown being H.K. 13.

Sowing was advanced in Mahaiyawa and Mavilmada areas, and plants flowered early but were subject to slight damage owing to the early July rains. Harispattu was late in sowing and suffered from the June drought. The one noticeable feature of the crops, however, was that the pure-line paddies were distinctly superior in growth and yield to the local varieties.

The judging which was carried out by the Agricultural Instructor resulted as follows :—

1. H. L. de Silva of Gohagoda in Harispattu Rs. 40-00
2. Mapanawature Punchi of Mahaiyawa in Yatinuwara Rs. 20-00

Vegetable Garden Competition in Harispattu.

A competition for small holders in Harispattu was held in the cultivation of vegetables when there were 28 entries each of about ¼ acre in extent. These gardens which had all been systematically cultivated yielded better crops than was obtained in previous years, and some of the cultivators realized as much as Rs. 70/- and Rs. 80/- each from the crops.

The gardens entered for competition were occasionally visited by the Agricultural Instructor and some of the gardens were selected for the final judging which resulted as follows :—

1st Prize. Medegederawatte cultivated by Kumburuwelagedera Dingiri Appu Rs. 25-00

2nd Prize. Deniyagederawatte cultivated by Kiriwelgadegedera Appuhamy Rs. 15-00

Matale South Vegetable Garden Competition, 1927-28.

A vegetable garden competition, which aroused the keenest interest among cultivators, was held in Matale South during 1927-28 in two divisions. In one division which comprised Kohonsiya, Gampahasiya and Udasiya Pattus there were 71 competitors an increase of 10 over last year, while in the other division which embraced Medasiya, Asgiri Udasiya and Pallaesiya Pattus there were 46 competitors.

All gardens entered for competition had been well manured with farm yard manure and in some cases with dry fish refuse obtained from boutiques.

Occasional visits were paid by the Agricultural Instructor who gave useful hints and also carried out the preliminary judging.

The final judging was conducted by the Divisional Agricultural Officer, who took into account extent of land cultivated, cleanliness, system adopted, varieties cultivated, tilth of soil, state of crop, freedom from diseases and pests, seed selection, and yield obtained, in awarding marks and adjudged the following as prize winners :—

Kohonsiya, Gampahasiya & Udasiya, Pattus.

1. Wattemedegedera Menik Appu of Padiwita Rs. 30-00
2. Lindagawagedera Welappu of Padiwita Rs. 20-00
3. Hettiaratchige Lenti of Padiwita Rs. 15-00

Medasiya, Asgiri Udasiya & Pallesiya, Pattus.

1. Sena Senjado Mahamado of Raitalawa Rs. 30-00
2. K. H. P. Banda Veda of Raitalawa Rs. 20-00
3. D. D. Ranatunga of Raitalawa Rs. 15-00

Mudaliyar Waidyasekera Prize Competition.

The competition organised in the North-Western Province for a prize offered by Mudaliyar W. Daniel Fernando Waidyasekera for the encouragement of the cultivation of medicinal herbs was held for the second time in 1927-28.

Due notice was given of the competition which is open to schools with registered gardens, and 28 schools entered, great enthusiasm being shown by the competitors.

Judging was done by the Divisional Agricultural Officer, North-Western, Kurugala, who assigned marks for the number of varieties grown as well as to their selection ; size of beds under each variety and manuring were also taken into consideration.

KU/Kobiogano School, the winner of the first prize, had grown no loss than 200 varieties.

The following are the prize winners :—

Kurunegala District.

1. Kobiogana B.V. School Rs. 25/-
2. Nakkawatte B.V. School ,, 20/-
3. Kirindewa B.V. School ,, 15/-
4. Bogamuwa V.B. School ,, 10/-

Puttalam—Chilaw District.

1. CH/Galmuruwa Rs. 15/-
2. P/Walpaluwa B.V. School ,, 15/-

Book Review.

The Department of Agriculture has been favoured with the following publications:—*Importance of an Adequate Intelligence Service for the Rubber Industry; Summary of Current Literature;* and *Library Catalogue,* issued by the Research Association of British Rubber and Tyre Manufacturers.

The first is a paper read by S. S. Pickles, D.Sc., F.I.C., Chairman of the Library and Information Bureau Committee of the Research Association of British Rubber and Tyre Manufacturers, at a meeting of the London Section of the Institute of the Rubber Industry on December 7, 1925. In this paper Dr. Pickles discusses fully the importance of an Information Bureau for the Rubber Industry and urges first, the need for the provision of a special rubber library for collecting and arranging in the best accessible manner all available literature on the rubber and allied industries and second, presenting such information as has been gathered from the above literature in a form in which it can be readily absorbed and utilised by the receipients. He suggests that such a venture could be economically undertaken by the co-operation of the different Institutes and Associations and in establishing a central library. In this connection as an alternative proposal he suggests the Institute to take advantage of the library of the Research Association of British Rubber and Tyre Manufacturers at Croydon and praises highly the work that is being done by the research staff of that Association with regard to the issuing of the *Summary of Current Literature,* and the services of this staff, he says, will be at the disposal of the Institution of the Rubber Industry. Further he hopes that with the establishment of an Information Bureau on the lines proposed by him it will be possible with the aid of the Department of Overseas Trade and the Statistical Department of the Board of Trade to issue commercial statistics in the form of a trade supplement to the *Summary of Current Literature.*

These suggestions made by Dr. Pickles, as is shown by the discussion following upon the paper, if realized, would be in the best interests of the rubber industry as a whole.

The Summary of Current Literature (Received Vol. VI. No. 3. March, 1928) is a publication issued monthly embodying a summary of the contents of all the important technical and scientific journals dealing with the rubber industry and which appeared since the preceding issue of this publication. The work of abstracting suitable information from current literature is in the hands of a staff of highly scientific and efficient officers of the Information Bureau of the Research Association of British Rubber and Tyre Manufacturers and it has correspondents all over the rubber growing world. The fact that the *Summary* has been divided into different sections that come under the industry has facilitated matters for the reader and in our opinion such facilities would be enhanced if an index is attached to each issue. The value of this publication to those engaged in the rubber industry, especially on the technical side of it, cannot be exaggerated.

The Library Catalogue is an efficiently got up book containing the titles of a very wide collection of British and foreign publications dealing with the rubber and allied industries. The different kinds of entries viz. title, author, subject, etc., are made in distinctive types and are arranged in alphabetical order enabling easy reference. A list of rules governing reference and the loan of books is included in the Catalogue.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED 30th SEPTEMBER, 1928.

Province, &c.	Disease	No. of Cases up to date since Jan. 1st, 1928	Fresh Cases	Recoveries	Deaths	Balance Ill	No. Shot
Western	Rinderpest	402	164	47	335	10	10
	Foot-and-mouth disease	2724	200	2606	6	112	...
	Anthrax	...	...	...	...	...	...
	Piroplamosis	6	...	5	1	...	...
	Rabies*. (Dogs)	2	1	...	1	...	1
Colombo Municipality	Rinderpest	907	274	56	788	62	1
	Foot-and-mouth disease	285	17	273	10	2	...
	Anthrax	1	...	...	1	...	...
	Rabies (Dogs)	40	12	...	...	...	40
Cattle Quarantine Station	Rinderpest	77	...	43	34	...	...
	Foot-and-mouth disease	76	...	72	4	...	...
	Anthrax	...	...	..	...	...	...
Central	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	2079	579	1822	27	229	1
	Anthrax	...	...	...	...	...	...
	Black Quarter	3	...	...	3	...	...
	Rabies (Dogs)	12	5	...	...	...	12
Southern	Rinderpest	9	9	1	8	...	...
	Foot-and-mouth disease	34	34	23	...	11	...
	Anthrax	...	...	...	...	...	...
	Piroplasmosis	9	9	6	3	...	...
Northern	Rinderpest	...	...	..	...	...	...
	Foot-and-mouth disease	1504	...	1079	50	375	...
	Anthrax	...	...	...	...	...	...
Eastern	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	1340	950	1307	3	30	...
	Anthrax	...	...	...	...	...	...
North-Western	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	3862	175	3711	33	116	2
	Anthrax	...	...	...	...	...	...
	Rabies (Horses)	3	3	...	3	...	...
North-Central	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	4162	...	1391	19	2752	...
	Anthrax	...	...	...	...	...	...
Uva	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	35	25	26	...	9	...
	Anthrax	...	...	...	...	...	...
Sabaragamuwa	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	2378	110	2276	39	63	...
	Anthrax	...	...	...	...	...	...

* 1 case. A calf. Animal died.

G. V. S. Office,

G. W. STURGESS,

METEOROLOGICAL

SEPTEMBER, 1928.

Station	Temperature: Mean Daily Shade	Temperature: Difference from Average	Mean Humidity	Mean amount of Cloud 0=clear 10=overcast	Mean Wind Direction during Month	Daily Mean Velocity	Rainfall: Amount	Rainfall: No. of Rainy Days	Rainfall: Difference from Average
	°	°	%			Miles	Inches		Inches
Colombo Observatory	82·5	+2·3	74	7·0	SW	166	1·44	16	— 5·08
Puttalam	83·0	+1·8	74	5·8	SW	215	0·06	1	— 1·09
Mannar	84·6	+1·6	72	5·2	S	259	0·00	0	— 1·13
Jaffna	82·5	+0·8	80	5·0	SW	314	0·30	2	— 2·61
Trincomalee	85·8	+2·2	65	5·0	SW	192	1·92	10	— 2·51
Batticaloa	84·2	+0·7	67	3·4	Var.	154	1·25	1	— 1·46
Hambantota	83·2	+2·0	74	3·9	WSW	383	0·57	3	— 1·93
Galle	81·0	+1·0	81	6·8	WNW	295	3·16	19	— 5·18
Ratnapura	81·1	+1·1	76	6·0	—	—	8·15	21	— 7·06
Anu'pura	84·6	+1·2	66	5·8	—	—	0·12	1	— 2·92
Kurunegala	82·0	+1·1	71	7·4	—	—	1·13	9	— 4·37
Kandy	76·4	+1·3	76	5·7	—	—	3·07	13	— 2·98
Badulla	74·7	—0·1	70	3·6	—	—	0·62	6	— 2·95
Diyatalawa	69·0	+0·2	66	5·5	—	—	2·48	7	— 1·61
Hakgala	64·0	+0·5	83	5·6	—	—	1·61	9	— 4·64
N.' Eliya	59·7	+0·7	81	7·5	—	—	3·07	13	— 5·43

The rainfall of September was very deficient and out of over 300 stations only six reached their average. These six were all on the east side and only one of them passed its average with as much as a couple of inches to spare.

The highest totals were at Watawala, Blackwater and Kenilworth, each with a little over 17 inches but with deficits of the order of ten inches below their averages. The shortage was marked up to the 21st, after which there was some attempt at recovery, *e.g.*, at Watawala where over an inch was recorded on each of seven of the last nine days of the month. On the western side deficits in quantity were more marked than deficits in the number of days on which rain fell.

The resultant total for the five months April to September inclusive, has been below average at nearly all stations in the south-west quarter of the island *i.e.*, those at which the south-west monsoon averages are high, a result in accordance with expectation, *vide* the April report in this series, and the periodicity referred to in the 1927 Observatory Report.

A. J. BAMFORD,

Supdt. Observatory.